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Introduction

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1. Scientific and technical reports of the National Aeronautics and Space Administration and its contractors.
2. Scientific and technical reports of government agencies, universities, and research organizations throughout the world.
3. Scientific and technical articles prepared by employees of NASA and its contractors that appear in the learned and technical journals.

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National Aeronautics and Space Administration

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VOLUME 2 NUMBER 19

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

October 8, 1964

01 GENERAL

Includes administration and management; space law and related legal matters; legislative hearings and documents; and symposia or conferences of a broad or general nature.

N64-27020 Air Force Systems Command, Wright-Patterson AFB, Ohio Research and Technology Div.
SUMMARY OF THE SEVENTH REFRACTORY COMPOSITES WORKING GROUP MEETING, VOLUME II
L. N. Hjelm, Darrell R. James, and C. S. Lee Nov. 1963 284 p refs Meeting held at Palo Alto, Calif., 12–14 Mar. 1963
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9. PROGRESS BRIEFING FOR REFRACTORY COMPOSITES WORKING GROUP MEETING, 12–14 MARCH 1963 J. C. Ingram, Jr. (Aeron. Systems Div.) p 442–449 (See N64-27026 19-18)

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13. DEVELOPMENT OF PROTECTIVE COATINGS FOR REFRACTORY ALLOYS M. H. Ortner (Vitro Labs.) p 509–516 (See N64-27030 19-18)

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15. SURVEY OF CERAMIC RESEARCH PROGRAMS SPONSORED BY GOVERNMENT AGENCIES N. L. Hecht (Picatinny Arsenal) p 545–580 (See N64-27032 19-19)

16. PRELIMINARY REPORT ON GRAPHITE COMPOSITES G. M. Harris (Avco Corp.) p 581–589 (See N64-27033 19-19)

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N64-27171 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow Radio Research Station
WORLD DATA CENTRE C. ROCKETS AND SATELLITES LIST OF REPORTS AND REPRINTS RECEIVED DURING THE PERIOD 1ST JULY 1963–31ST DECEMBER 1963
[1963] 32 p refs

The reports and reprints listed are classified according to subject matter, including space research in general, satellites and probes, tracking, instrumentation, space environment, geophysics, and plasma physics. D.S.G.

N64-27208 National Science Foundation, Washington, D.C.
COUNTRY REPORTS ON THE ORGANIZATION OF SCIENTIFIC RESEARCH: UNITED STATES
Mary E. Corning Organisation for Econ. Co-operation and Develop. [1963] 92 p refs

Because of the lack of concise and reliable information on the organization of sciences in member countries of the Organization for Economic Co-operation and Development, it was

decided that reports should be prepared by the countries themselves, but that a uniform pattern in subject material and terminology should be followed. The subject of the survey is the mechanism of research, including information on the establishments organizing and promoting scientific research. The reports concentrate on the natural sciences (pure and applied science and technology); educational matters are included only insofar as they pertain to a country's research efforts. D.S.G.

N64-27237 Congress House Committee on Science and Astronautics
1965 NASA AUTHORIZATION, INDEX FOR HEARINGS BEFORE THE COMMITTEE ON SCIENCE AND ASTRONAUTICS, U.S. HOUSE OF REPRESENTATIVES, EIGHTY-EIGHTH CONGRESS, SECOND SESSION, ON H.R. 9641 (SUPERSEDED BY H.R. 10456), FOR PARTS 1-2-3-4
Washington, GPO, 1964 81 p GPO: $0.25

The index of personal names and the subject index, together with page numbers on which these references can be found, are presented for the hearings before the Committee on Science and Astronautics, U.S. House of Representatives, 88th Congress, Second Session. R.T.K.

N64-27497 Army Research Office, Durham, N.C.
RESEARCH IN PROGRESS DURING CALENDAR YEAR 1963
[1964] 277 p refs
(AD-601472)

This is a review of U.S. Army research projects currently in progress in the fields of physics, chemistry, mathematics, engineering, metallurgy, and ceramics. The scope of each project, the progress made to date of publication, and the reports covering the project are given. An extensive cross-reference index is included listing the projects by contract number, grant number, contractor, subject, and principal investigator. G.D.B.

N64-27637 Joint Publications Research Service, Washington, D.C.
CYBERNETICS, PLANNING AND SOCIAL PROGRESS
21 Aug. 1964 22 p Transl. into ENGLISH from Ekon. Gaz. (Moscow), No. 25, 20 Jun. 1964 p 7-9, 17
(JPRS-26063; TT-64-41333) OTS: $1.00

This is an article giving some opinions of prominent Soviet economists, mathematicians, philosophers, and engineers on cybernetics. Many references are made to Western thinking on the subject, with appropriate Russian rejections. G.D.B.

02 AERODYNAMICS OF BODIES, COMBINATIONS, AND INTERNAL FLOW

Includes aerodynamics of channels, cowls, ducts, ejectors, nozzles, etc. *For related information see*: 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 11 Fluid Mechanics.

N64-26977 Aeronutronic, Newport Beach, Calif.
AN INVESTIGATION AND DEVELOPMENT OF FILM PROTECTED-CONVECTIVELY COOLED NOZZLES First Quarterly Technical Report
W. H. Armour, R. L. Mitchell, H. L. Moody, A. M. Saul, W. L. Smallwood et al 22 May 1964 104 p refs
(Contract AF 04(611)-9705)
(U-2621; RPL-TDR-64-79; AD-602499)

Detail analytical and experimental studies were conducted on internal convection and conduction heat transfer, coolant selection, thermochemistry, and the fluid mechanic aspects of injection through discrete holes in a reacting turbulent boundary layer. Laboratory experiments were conducted to provide insight, data, and direction to the analysis. Author

N64-27238* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A TECHNIQUE FOR INCLUDING THE EFFECTS OF VEHICLE PARAMETER VARIATIONS IN WIND RESPONSE STUDIES
J. A. Lovingood 1 May 1964 28 p
(NASA-TM-X-53042) OTS: $2.60 ph

A method is presented for performing vehicle wind response studies including the effects of variations in vehicle data such as aerodynamic and mass characteristics. These variations are combined in such a manner as to yield a 99.87% probability value for the maximum bending moment experienced by the vehicle when flying through a deterministic wind profile. A step-by-step procedure is presented for calculating the moment and other flight-dynamic parameters. Author

N64-27286* Aerojet-General Corp., Sacramento, Calif.
STUDY OF HIGH EFFECTIVE AREA RATIO NOZZLE FOR SPACECRAFT ENGINES Final Report, 18 Apr. 1962-18 Feb. 1964
Jun. 1964 343 p refs
(Contract NAS7-136)
(NASA-CR-56978; NAS7-136-F, Vol. 2) OTS: $19.75 ph

Thermal and chemical kinetic loss calculations are given. Shear drag losses and their reduction are presented. The geometrical thrust losses and optimum nozzle contour design are discussed. Two-phase flow losses are described. An analysis is made of a swirling-flow nozzle, as well as one of an aerodynamic nozzle. The mission of the spacecraft engines covered in this report is analyzed. The meteoroid hazard is examined. The effects of increased bending moment on the boost stages due to an increase in interstage weight between the booster and space vehicle are given. G.D.B.

N64-27536 Giannini Controls Corp., Malvern, Pa. Astromechanics Research Div.
SEPARATED FLOW IN CURVED CHANNELS WITH SECONDARY INJECTION
H. A. Curtiss, O. G. Feil, and D. J. Liquornik 25 May 1964 40 p refs
(Contract AF 49(638)-1218)
(ARD-TR-020-01; AFOSR-64-0860; AD-602487)

Injection of secondary fluid flow into a primary flow confined in a curved channel is a powerful technique for use in fluid state amplification. The secondary injection continuously and progressively alters the separation characteristics of the confined primary flow, resulting in large proportional changes in the channel output flows. A fundamental study of the method with incompressible, turbulent boundary layer flow in a range of varying curvature channels was conducted to learn about the flow characteristics and passage shape parameters relevant to proportional amplification. Several injection methods and velocities were investigated with the main emphasis on the effects of this injection on the flow characteristics within the channels. Preliminary analytical techniques were developed that compared favorably with the experimental results. An overall comparison of the mass flow and momentum gains obtainable for various injection and channel configurations is presented. Author

N64-27657* National Aeronautics and Space Administration, Washington, D.C.
RE-ENTRY HEATING EXPERIMENT TO BE FLOWN BY SCOUT News Release No. 64-202
11 Aug. 1964 7 p Available from the Scientific and Technical Information Division

The reentry heating experiment to be flown by a Scout vehicle has two objectives—to compare flight with ground test data on ablator materials, and to provide a basis for assessment of the material as a possibility for use in the Apollo flight. Total Scout payload weight will be about 370 lbs, and at start of reentry just under 182 lbs. No attempts will be made at recovery after the drop in the Atlantic Ocean about 400 miles southeast of Wallops Island. Radar, telemetry, and optical coverage will be used to gather data. A.W.

N64-27687 Space Technology Labs., Inc., Redondo Beach, Calif.
A REVIEW AND APPLICATION OF STAGNATION POINT AND LAMINAR BOUNDARY LAYER SIMILAR SOLUTIONS TO HEAT TRANSFER
J. T. Ohrenberger Sep. 1963 58 p refs
(Contract AF 04(694)-1)
(Rept.-6721-7506-KU-000; BSD-TDR-63-207; AD-440806)

A review of existing compressible laminar boundary-layer similar solutions is presented. Expressions for calculating stagnation point and laminar boundary-layer heat transfer, applicable to vehicles both during ascent and reentry, are given. These equations form the basis for an aerodynamic-heating computer program currently in operation at STL. The review includes a comparison between reacting gas, variable property solutions, and perfect gas solutions in which viscosity is proportional to temperature. Author

N64-27695 Picatinny Arsenal, Dover, N.J. Engineering Sciences Lab.
TRANSVERSE MOMENTS OF INERTIA BY MECHANICAL INTEGRATION
S. L. Gerhard May 1964 10 p
(PA-TM-1423; AD-600886)

The formula $I_t = 3.380\,(P'' - P')$ derived earlier is valid for any point on the axis of revolution, including the c.g. of the composite shell. The proper orientations of the drawing must be used when traversing the figure, to establish the proper signs of P'' and P'. The procedure is described in sufficient detail to avoid ambiguity, and is illustrated by a numerical example. Corrections to an earlier report are listed. The formula for the third moment of area, P, to be used on the Amsler Type 2002 Integrator, may be used for areas lying below the axis by writing it

$$P = -(c_1 a - c_2 / m / + c_3 i)$$

where a, m, and i are the usual differences between initial and final readings of the three drums, and c_1, c_2, and c_3, are the constants appropriate for the particular arm length being used. Author

N64-27783 Martin Co., Baltimore, Md. Space Systems Div.
REVIEW OF FREEZING POINT TECHNIQUES FOR COMPUTING RELAXATION FLOWS
R. Phinney Mar. 1963 35 p refs
(RM-143)

Scattered information on single-component nonequilibrium flow in nozzles is collected, compared, and presented in useful form. The data are compared with the freeze point criteria of Bray and of Hall and Russo for dissociational relaxation, and with a similar approximation for the vibrational case. For all cases where a single reaction can be assumed to dominate, it is shown that the freezing criterion is accurate and is within the accuracy with which the chemistry is known. Author

N64-27793 Lockheed Missiles and Space Co., Sunnyvale, Calif.
AERODYNAMIC CHARACTERISTICS OF BODIES OF REVOLUTION WITHOUT FANS An Annotated Bibliography, Jan. 1960–Jun. 1963
George R. Evans, comp. Jul. 1963 219 p refs
(Contract NOw-63-0050-c)
(SB-63-75; Rept.-8-4-63-13; AD-440886)

The bodies of revolution may be of any configuration. The references are listed by personal author or, in the absence of one, listing is by title. The first 15 references are listings of bibliographies, handbooks, and literature surveys of aerodynamics in general. Source–agency and subject indexes are included. The subject index is divided as follows: (1) bodies of revolution with arbitrary configuration; (2) specific types of configurations, such as cones, cylinders, and blunt bodies; and (3) specific vehicles, e.g., Polaris, Titan, and Minuteman. Author

03 AERODYNAMICS OF WINGS, ROTORS, AND CONTROL SURFACES

Includes ailerons; airfoil sections; cascades; fans; flaps; propellers; rotors; slats; spoilers; etc. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 11 Fluid Mechanics.

N64-27345 Max-Planck-Institut Für Stromungsforschung, Göttingen (W. Germany)
MEASUREMENTS OF THE AERODYNAMIC DERIVATIVES OF OSCILLATING AIRFOIL PROFILES IN WIND TUNNEL AND A COMPARISON TO THEORY [MESSUNGEN DER AERODYNAMISCHEN BEIWERTE SCHWINGENDER FLUGELPROFILE IM WINDKANAL UND VERGLEICH MIT DER THEORIE]
J. Spurk (Aerodynamische Versuchsanstalt Göttingen) 1963 99 p refs In GERMAN *Its* Mitteilungen No. 29

The aerodynamic derivatives of five symmetrical Joukowsky and Mises airfoil profiles, of various thicknesses and cords, were measured in the two-dimensional flow of a 3-m wind tunnel by means of an electronic oscillation measuring instrument. The profiles were fastened to a flexible beam having an adjustable fulcrum. The profiles oscillated between stationary plane walls in a finite two-dimensional free jet. The aerodynamic forces and moments acting on the beam were measured. The results obtained were recalculated for unlimited flow and were compared with the theory of oscillating airfoils of finite thickness of H. G. Küssner and G. v. Gorup. Large deviations were observed by Reynolds numbers under 3×10^5. I.v.l

N64-27662* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF PROPELLER WHIRL FLUTTER OF A POWER PLANT ON A FLEXIBLE WING
Robert M. Bennett and Samuel R. Bland Washington, NASA Aug. 1964 71 p refs
(NASA-TN-D-2399) OTS: $1.75

Results of an investigation of propeller whirl flutter are presented for a model consisting of a single propeller and simulated powerplant mounted with flexibility in pitch and yaw

to a cantilevered, semispan wing. Several configurations differing in the powerplant parameters were investigated analytically and experimentally. An analysis is presented employing four uncoupled modes—wing bending, wing torsion, powerplant pitch, and powerplant yaw. Experimental results are compared with this four-mode analysis and with an analysis including only powerplant freedoms. The experimental and analytical results indicate that the effects of the wing on the whirl flutter boundary were large for some cases, depending on the system parameters, and were generally stabilizing for the configurations considered. The four-mode analysis generally gave better results than the two-mode analysis, but only gave fair agreement in some instances. The analyses indicated that in cases of large-amplitude wing motion, wing aerodynamics can have significant stabilizing effects. Author

N64-27751 Toronto U., (Canada) Inst. for Aerospace Studies
THE NOISE OF AIRCRAFT
Herbert S. Ribner [1964] 24 p refs Presented at the Intern. Council of the Aeron. Sci., 4th Cong., Paris, 24–28 Aug. 1964
(Grant AF-AFOSR-223-64)
(AIAA Paper-64-545) AIAA: 3fr.

Current concepts are presented concerning the noise from jets, compressors, boundary layers, and sonic booms, which are drawn in part from recent theoretical and experimental research. Where possible, simple physical models of the major features of the noise and vibration phenomena are given. The noise from combustion and from propellers and rotors is dealt with more briefly. Some mention is made of acoustical fatigue. Author

N64-27752* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A NUMERICAL METHOD OF ESTIMATING AND OPTIMIZING THE SUPERSONIC AERODYNAMIC CHARACTERISTICS OF WINGS OF ARBITRARY PLANFORM
Wilbur D. Middleton and Harry W. Carlson N.Y., AIAA [1964] 8 p refs Presented at the AIAA Transport Aircraft Design and Operations Meeting, Seattle, 10–12 Aug. 1964
(AIAA Paper-64-590) AIAA: $0.50 members, $1.00 nonmembers

This paper illustrates the application of numerical methods to wing camber surfaces of arbitrary planform to obtain the surface shape required to support a specified pressure distribution or, inversely, to obtain the pressure distribution on wings of specified shape. In the direct solution, the surface shape corresponding to an optimum combination of loadings (for least drag at a specified lift) may be obtained; in the inverse solution, the pressure distribution on a flat wing of arbitrary planform may be obtained. Used in combination, the numerical methods allow the determination of linear theory drag-due-to-lift polars and lift-moment relationships for wings of arbitrary planform that may employ any specified surface shape. With attention given to the real flow considerations that limit the application of linear theory, studies of the aerodynamic characteristics of arbitrary wing planforms with various surface shapes may be analytically conducted. Author

N64-27782 Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (W. Germany)
TRANSONIC FLOW AGAINST TWO-DIMENSIONAL WINGS. SECOND REYNOLDS—PRANDTL LECTURE, COLOGNE, MARCH 1964 [TRANSSONISCHE STROMUNG AN ZWEIDIMENSIONALEN FLUGELN. ZWEITE REYNOLDS—PRANDTL—VORLESUNG, KOLN, 23 MARZ 1964]
D. W. Holder (Oxford U.) 23 Mar. 1964 61 p In GERMAN

Transonic flow against two-dimensional wings is reviewed in the light of flow development when the Mach number of the initial flow is raised at a steady angle-of-attack. Emphasis is placed on the existence of a "mixed" region of subsonic and supersonic motion within the flow field. The case treated is one wherein a supersonic region, which is generated by isentropic expansion on the wings, is embedded in the surrounding subsonic flow. I.v.L.

N64-27789 Itek Corp., Palo Alto, Calif.
THEORETICAL AERODYNAMICS OF FLEXIBLE WINGS AT LOW SPEEDS. II: TWO-LOBED PARAWINGS
Jack N. Nielsen, Richard Barakat, Fredrick K. Goodwin, and Morton Rudin 1 May 1964 98 p refs
(Contract Nonr-3728(00))
(VIDYA-133; AD-601848)

On the basis of slender-body wing theory, the geometric and aerodynamic characteristics of two-lobed parawings have been completely determined. Such wings have a vertical plane of symmetry and possess a cusp at the root chord at the same elevation as the leading edges. By superposing the two-lobed solutions with previously determined one-lobed solutions, it is possible to determine the properties of parawings in which the root chord (keel) is not at the same elevation as the leading edges. As examples of such parawings, the family of parawings with no leading-edge singularity has been determined, and the effectiveness of changes of keel incidence for the production of lift has been calculated. Tabular data for use in aerodynamic design have been presented, together with several calculative examples. Author

04 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc., and specific types of complete aircraft (e.g., Ground Effects Machines, Flexible Wings, STOL, and VTOL); flight tests; operating problems; safety devices; and stability and control. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 30 Space Vehicles.

N64-26978 Northrop Corp., Hawthorne, Calif. Norair Div.
LAMINAR FLOW CONTROL AIRPLANE DEMONSTRATION PROGRAM, ADVANCED TECHNOLOGY PROGRAM SYSTEM 659A LFC Summary Flight Test Report
W. W. Stark Apr. 1964 489 p refs
(Contract AF 33(600)-42052)
(NOR-61-134; AD-440344)

The X-21A laminar flow control demonstration program provided for the design, fabrication, and flight testing of two X-21A experimental test airplanes to demonstrate the feasibility of laminar flow control and the resulting gains in range-payload performance relative to a turbulent airplane. Author

N64-27070* National Aeronautics and Space Administration. Washington, D.C.
V/STOL AIRCRAFT NASA Facts, Vol. II, No. 3
[1964] 8 p GPO: $0.15

The NASA V/STOL (vertical short takeoff and landing) program is described. This program is set up to study aircraft capable of landing and taking off vertically, or with a relatively short ground run. Some of the configurations that have been studied, and the development of several that have been carried as far as the flight-test stage are discussed. These include helicopters, propeller, ducted fan, and jet configurations. At

present, the helicopter is the only operational VTOL (vertical takeoff and landing) aircraft. R.T.K.

N64-27122* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

BASE PRESSURE COEFFICIENTS OBTAINED FROM THE X-15 AIRPLANE FOR MACH NUMBERS UP TO 6

Edwin J. Saltzman Washington, NASA, Aug. 1964 47 p refs (NASA-TN-D-2420) OTS: $1.25

Power-off and power-on base pressures measured on the X-15 airplane are compared with wind-tunnel data, semiempirical estimates, and theory. The results indicate that the supersonic base pressure characteristics of the upper vertical fin are relatively insensitive to span position and are closely predicted by two-dimensional theory for thin boundary layers. Flight power-off base pressure coefficients for the fuselage, side fairing, and vertical fin are higher (higher negative values) than those obtained on X-15 wind-tunnel models throughout a comparable speed range. At a Mach number of 3, the flight values are about 15% higher. For most supersonic speeds, the effect of the exhaust jet on the base pressure is about the same along the vertical fin as at the fuselage flameshield; that is, the effect is about the same 5 jet radii from the edge of the jet as it is 1/5 radius from the jet. Author

N64-27140 Aerodynamische Versuchsanstalt, Gottingen (W.Germany)

FLIGHT TESTS ON THE STRUCTURAL TYPE Do 27 WITH BOUNDARY-LAYER REMOVAL BY SUCTION TO INCREASE MAXIMUM LIFT [FLUGVERSUCHE AM BAUMUSTER Do 27 MIT GRENZSCHICHTABSAUGUNG ZUR STEIGERUNG DES HOCHSTAUFTRIEBS]

F. Schwarz and W. Wuest [1962] 36 p refs In GERMAN (AVA-63-02)

It is shown through flight tests with an aircraft of the Do-27 structural type that values of maximum lift, similar to those with leading-edge slots, can be obtained through sucking off the boundary layer near the wing's leading edge. In addition, the total flight resistance is about 15% lower. Trans. by D.E.W.

N64-27227 Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (W. Germany) Inst. für Strahlantriebe

THE THRUST REQUIREMENTS OF ADVANCED JET AIRCRAFT [DER SCHUBBEDARF NEUZEITLICHER STRAHLFLUGZEUGE]

Lutz von Bonin 1964 12 p refs Repr. from Luftfahrttech.-Raumfahrttech. (W. Germany), v. 9, no. 12, 1963 p 344–354 In GERMAN (DFL-233)

A survey of the thrust requirement of modern jet aircraft is given, centering on VTOL-supersonic aircraft for pursuit and combat, and on supersonic commercial aircraft. The thrust of a jet aircraft requisite to the accomplishment of a definite flight mission is analyzed by flight function and displayed by means of suitable proportions, which consist of the thrusts and the takeoff weights. Thus, the aircraft family already derived from the adjusted flight problem through the proportion—takeoff thrust/takeoff weight—can be sufficiently characterized, and a statistical investigation is performed. The thrusts required for either cruising or maximum flight conditions can, on the other hand, be clarified nomographically and roughly predetermined through simple relations of the mechanical flight performance when drawing up definite aircraft characteristics. Finally, a corresponding comparison among the single aircraft families is usable. Trans. by D.E.W.

N64-27380* United Aircraft Corp., Norwalk, Conn. Norden Div.

STUDY OF DISPLAY INTEGRATION FOR HYPERSONIC RESEARCH VEHICLES Final Engineering Report, 15 May–15 Nov. 1963

C. F. Schaefer 15 Nov. 1963 159 p refs (Contract NASw-675) (NASA-CR-58177; Rept.-1141-R-0004) OTS: $11.50 ph

The mission profile of the X-15 research vehicle is analyzed in terms of pilot display requirements and vehicle characteristics. Present methods of flight information display are discussed. Design criteria for integrated display systems are presented, and a display format based on contact analog techniques is developed. Pilot control tasks for a selected mission are analyzed in detail, and application of the integrated display is described. A mechanization of a complete display system is described in terms of performance capabilities and physical characteristics, and is related to present display methods. Author

N64-27437 Air Force Cambridge Research Labs., Bedford, Mass.

A PRELIMINARY EVALUATION OF THE CRICKETSONDE ROCKET SYSTEM

Konstantins Pocs Jun. 1964 21 p refs *Its* Instrumentation Papers No. 43 (AFCRL-64-469; AD-603592)

Test flights of the Cricketsonde rocket were conducted to determine the operational feasibility of this low-level meteorological rocket system. Designed as an inexpensive, reliable, and safe method for obtaining meteorological data up to 3,000-ft altitude, the Cricket employs a cold-type propellant and a 403-mc radiosonde telemetry package, which is ejected at apogee and descends by parachute. Flight results indicate that the Cricketsonde has a good potential as an operational system. Problem areas relating to its optimum use are explored. Author

N64-27515 College of Aeronautics, Cranfield (Gt. Brit.)

AEROPLANE DESIGN STUDIES: CONVENTIONAL AND V.T.O.L. FREIGHTER AIRCRAFT (ACADEMIC YEARS 1959 AND 1961)

D. Howe Nov. 1963 41 p refs (COA-AERO-171)

Examples of the design studies are the F-59 freighter and its derivative the F-61 VTOL freighter. In a conventional role these designs are intended to carry a payload of up to 77,000 lb, over 800-nmi range, using four turboprop engines. The VTOL capability is given to the F-61 design by the addition of two wing pods, each of which houses 22 lift engines. The application of boundary-layer control in the form of blown ailerons and flaps has been investigated for the F-59 design. Both aircraft have been designed in detail. The major conclusion of the studies is that the application of VTOL to large freight aircraft is feasible, but further detailed work is necessary to resolve some flutter and noise problems. Author

N64-27609 Army Aeromedical Research Unit, Fort Rucker, Ala.

NOISE PROBLEMS ASSOCIATED WITH THE OPERATION OF US ARMY AIRCRAFT

Jimmy L. Hatfield and Donald C. Gasaway Jun. 1963 148 p refs (USAARU-63-1; AD-421567)

This report describes and illustrates basic, as well as unique, characteristics of noise associated with the operation of Army aircraft. It summarizes the important facts relative to hazardous noise, its effects on man, the characteristics of noise

generators, noise reduction concepts, and future noise problems. Author

N64-27646* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DYNAMIC TESTS OF V/STOL TRANSPORT MODELS
Marion O. Mc Kinney and Robert H. Kirby N.Y., AIAA [1964] 16 p refs Presented at AIAA Transp. Aircraft Design and Operations Meeting, Seattle, 10–12 Aug. 1964
(AIAA Paper-64-619) AIAA: $0.50 members, $1.00 nonmembers

Propeller- and lift-fan-powered V/STOL transport types have certain dynamic stability problems (mainly unstable stick-fixed oscillations) in hovering and low-speed flight. These instabilities can be controlled by the pilot without the use of artificial stabilization, although artificial stabilization is quite helpful. As the airspeed approaches that required for normal wingborne flight, these instabilities are markedly reduced and usually disappear. In the approach condition for the tilt-wing type, that is, in descending flight in the transition speed range, very poor dynamic behavior can result from the tendency of the wing to stall if the aircraft is not properly designed to avoid this difficulty; this poor behavior limits the descent angles that the pilot is willing to use. The jet V/STOL types have been found to have no real dynamic stability problems other than those associated with static stability and trim characteristics such as pitchup, directional instability, and excessive pitch trim requirements, which can be determined by ordinary wind-tunnel tests and interpreted adequately without the need for special dynamic tests. Author

N64-27753* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PERFORMANCE TRADE-OFFS AND RESEARCH PROBLEMS FOR HYPERSONIC TRANSPORTS
Thomas J. Gregory, Richard H. Petersen, and John A. Wyss N.Y., AIAA [1964] 12 p refs Presented at the AIAA Transport Aircraft Design and Operations Meeting, Seattle, 10–12 Aug. 1964
(AIAA Paper-64-605) AIAA: $0.50 members, $1.00 nonmembers

Examination is made of the mission capability of hydrogen-fueled hypersonic transports, and some of the major technical approaches that may be used with such vehicles are discussed. Technical feasibility only is considered. Computations to determine the values of vehicle parameters were performed on a digital computer in conjunction with a trajectory computation. The vehicles chosen for analysis had large-volume fuselages, triangular wings, and suitable tail surfaces. Results of the study confirm that hydrogen-fueled hypersonic transports are capable of sustained flights to ranges approaching 1/2 the earth's circumference and that, at ranges in the neighborhood of 5,000 nautical miles, 15% to 20% of the gross takeoff weight is available for payload and fuel reserves. Hydrogen fuel is the key to this performance; cruise speed is of secondary importance. A.W.

N64-27827 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
KAI-19
M. Simonov 23 Apr. 1964 12 p Transl. into ENGLISH from Kryl'ya Rodiny (USSR), No. 12, 1963 p 22–24
(FTD-TT-64-341/1+2; AD-600818) OTS: $0.50

This is a description of a Soviet-designed glider (KAI-19) equipped to accomplish flights under complicated meteorological circumstances at an altitude up to 14,000 m. The cockpit is provided with an inflow and withdrawal system of ventilation. Located at the point of greatest pressure in the nose part of the fuselage is the intake system of ventilation, and the outlet opening is at the central hatch of the fuselage. The wing is wholly metallic. A.W.

N64-27849 General Dynamics/Convair, San Diego, Calif.
OPEN OCEAN DEMONSTRATION OF VERTICAL FLOAT SEA-STABILIZATION CONCEPT, PHASE II TESTS
D. B. Dewey, Jr. Jun. 1964 38 p refs
(Contract NOw-63-0793-f)
(GD/C-64-197; AD-603231)

Earlier reports have detailed the effects of installing vertical floats on the PBM dynamic model and full-scale seaplane in minimizing wave induced motions. All testing to date has dramatically demonstrated the effectiveness of vertical floats in creating a stable platform in waves. Full-scale experiments have now been completed successfully in waves up to 10 feet in height and in winds up to 30 knots, with no major problems. The latest series of open sea tests have further verified the habitability of the stabilized platform in waves. In 1964, the crew aboard the conventional seaplane hull suffered extreme discomfort and motion sickness, contrary to the stable and comfortable ride experienced by the crew aboard the vertical float equipped vehicle. Author

N64-27854 Air Weather Service, Scott AFB, Ill.
DANGER TO JET AIRCRAFT FROM LIGHTNING
Herbert S. Appleman 1 Jul. 1964 8 p refs
(TR-179; AD-602765)

This report presents the latest available information on lightning hazards to jet aircraft. Included are the temperature and altitude range where most strokes are encountered, a brief discussion of the type of damage likely to be incurred, and a somewhat more detailed look into the possibility of fuel-tank explosions due to lightning and electrostatic discharges. Whereas the possibility of such explosions is small, aircraft using JP-4 fuel are generally more vulnerable to this hazard than those using gasoline or kerosene. It is concluded from this and other hazards associated with JP-4 that jet passenger aircraft, at least, should use kerosene fuels where possible. Author

05 ASTRONOMY AND ASTROPHYSICS

Includes celestial mechanics; and radioastronomy. *For related information see*: 12 Geophysics, and 29 Space Sciences.

N64-27068* National Aeronautics and Space Administration, Washington, D.C.
RESEARCH ON THE POLARIZATION OF LIGHT FROM PLANETS AND FROM SOME TERRESTRIAL SUBSTANCES [RECHERCHES SUR LA POLARISATION DE LA LUMIERE DES PLANETES ET DE QUELQUES SUBSTANCES TERRESTRES]
B. Lyot Jul. 1964 155 p refs Transl. into ENGLISH from Ann. de l'Observatoire de Paris, Section de Meudon, v. VIII, no. 1, 1929
(NASA-TT-F-187) OTS: $3.00

A study of the planets and of light scattered by various terrestrial substances are presented according to observations

made prior to 1929 and includes a description of the instruments, experimental methods, and results obtained. The results obtained from the planets are compared with those obtained from earth substances. Author

N64-27135* National Aeronautics and Space Administration, Washington, D.C.
INFRARED SPECTRUM OF MARS (λ 1.1–4.1μ) [INFRAKRASNYY SPEKTR MARSA λ 1.1–4.1μ]
V. I. Moroz Jun. 1964 18 p refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 41, no. 2, 1964 p 350–361
(NASA-TT-F-9010)

Observations of the infrared spectrum of Mars (defraction and prism) in the wavelength regions of 1.1μ to 2.5μ and 2.9μ to 4.1μ were made. A 125-cm reflector and two spectrophotometers with cooled lead-sulfide photocells were used. In the λ 1.1μ to 2.5μ region, the spectrum of the whole disk was obtained with a resolving power of approximately 400, and that of the polar cap was obtained with a resolving power of approximately 10. In this region, 12 planetary CO_2 absorption bands were detected, 7 of which had not been observed previously in the spectrum of Mars. The intensity of the CO_2 absorption bands at 1.6μ is of lower value than the one adopted previously. The relative concentration of CO_2 computed from the newly observed data is $40/p^2$, where p is the pressure in millibars. The pressure at the planet's surface is evidently much lower than 100 millibars. The presence of ice absorption bands in the polar cap spectrum was confirmed. Four unidentified absorption bands (3.43μ, 3.53μ, 3.59μ, and 3.69μ) were detected in the 2.9μ to 4.1μ region. Three of these, according to their position, correspond approximately to Sinton's life bands (3.45μ, 3.58μ, and 3.69μ). The relationship between the geometric albedo and wavelength is obtained, in the first approximation, for the 0.4μ to 4μ region. This relationship is in satisfactory agreement with the reflection spectra of limonites. Author

N64-27153 Joint Publications Research Service, Washington, D.C.
PRECISION MEASUREMENTS OF THE RADIO EMISSION FROM THE MOON AND THE SUN IN THE 4 MM WAVELENGTH BAND
A. G. Kislyakov and V. M. Plechkov *In its* Izv. VUZov: Radiophys., No. 1, 1964 19 Jun. 1964 p 64–72 refs (See N64-27151 19-08) OTS: $4.00

Measurements were carried out in the high-mountain region of Pamir (altitude 3,860 m above sea level). Radiation from the moon and from the sun were compared with the radiation of a black disc with known angular dimensions. The brightness temperature of the sun at 4 mm is 7,300° K ± 200° K, whereas the phase variation of the radio emission of the moon at this wavelength is $\overline{T}_e = [204 + 56 \cos(\Phi - 23°)]°$ K, where T_e is the average brightness temperature of the moon over the disc and Φ is the phase of the moon, reckoned from full moon. The accuracy of the measurement of the absolute value of T_e is not less than 4%. The results of the measurements are used to estimate the radiating ability of the moon's soil and to calculate the phase variation of the radio emission of the center of the moon's disc. Author

N64-27154 Joint Publications Research Service, Washington, D.C.
CONCERNING THE DETECTION OF WATER IN THE ATMOSPHERE OF VENUS
I. Ye. Salomonovich *In its* Izv. VUZov: Radiophys., No. 1, 1964 19 Jun. 1964 p 73–85 refs (See N64-27151 19-08) OTS: $4.00

In light of new data on the spectrum of the radio emission of the unilluminated side of Venus, the question is considered of the nature of the cloud layer of the planet and the possibility of observing water vapor in the atmosphere. Author

N64-27169 Joint Publications Research Service, Washington, D.C.
LINE STRENGTH IN MAGNETIC-DIPOLE TRANSITION IN THE HYPERFINE STRUCTURE OF THE ATOM
V. M. Rontorovich and G. Ye. Chernyak *In its* Izv VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 269–273 refs (See N64-27151 19-08) OTS: $4.00

Magnetic-dipole radiation connected with the spontaneous transitions between the hyperfine structure components of the atoms in the interstellar media has been observed. Calculation of the line strength is presented. G.D.B.

N64-27197* California Inst. of Tech., Pasadena
THE CALCULATION OF STELLAR PULSATION
Robert F. Christy Repr. from Rev. Modern Phys., v. 36, no. 2, Apr. 1964 p 555–571 refs
(Grant NsG-426)

Presented are methods for computing stellar pulsations, developed to provide a theoretical understanding of the RR Lyrae- and Cepheid-type pulsating stars. The calculations are based on the fact that the observed pulsational motions in these stars arise spontaneously, because of the particular physical properties of the envelopes. The relevant physical properties are incorporated into the equations of state and of opacity. The computation proceeds by integrating the time-dependent equations of hydrodynamics (with spherical symmetry) and heat flow by numerical means. The equation of state is obtained by assuming a perfect gas of H, H^+, He, He^{++}, and electrons. The calculation of the motion of the envelope is carried out omitting the core of the star where nuclear energy is made available. Results obtained from a theoretical model are discussed in detail. IAA

N64-27198 Royal Observatory, Edinburgh (Gt. Brit.)
ASTRONOMICAL DISCUSSIONS ON PROBLEMS OF THE INTERSTELLAR MEDIUM AND GALACTIC STRUCTURE
N. M. Pratt and V. C. Reddish, ed. Edinburgh, HMSO, 1964 104 p refs *Its* Publ., v. IV Presented at the Meeting of the Royal Astron. Soc., Edinburgh, 19–20 Sep. 1963 HMSO: £1

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8. THE DISTANCE TO THE GALACTIC CENTRE R. v. d. R. Woolley (Royal Greenwich Obs.) p 103–106 refs

N64-27199 Observatorium Bosscha, Bandung (Indonesia)
ELEVEN NEW PLANETARY NEBULAE
P. K-Sin The 1964 4 p refs *Its* Contributions no. 28

A total number of 11 planetary nebulae were found in a region of approximately 25 square degrees in Sagittarius. The center of this region is at R.A. = $17^h\ 50^m$; Dec. = $-20°$ (1950). Coordinates and finding charts are given in this paper. Author

N64-27303* Arizona U., Tucson Lunar and Planetary Lab.
LUNAR AND PLANETARY LABORATORY SECOND SEMI-ANNUAL STATUS REPORT, 1 DECEMBER 1961–1 JUNE 1962
Gerard P. Kuiper et al [1962] 20 p
(Grant NsG-161-61)
(NASA-CR-56888) OTS: $1.60 ph

The laboratory has been concerned with the preparation and publication of major collections of scientific records as well as with research. Two editions of Part II of the "Orthographic Atlas of the Moon," one carrying the orthographic grid alone and the other having the latitude–longitude grid as well, have been issued, completing the atlas, which combines lunar-coordinate information with high-quality photography. Studies associated with the preparation of the "Rectified Lunar Atlas" and with the globe photography program are described, and a list of communications published by the laboratory on lunar and planetary studies is included. D.S.G.

N64-27354* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
SURFACE X-RAY EMISSION FROM NEUTRON STARS
Hong-Yee Chiu and E. E. Salpeter Repr. from Phys. Rev. Letters, v. 12, no. 15, 13 Apr. 1964 p 413–415 refs
(NASA-RP-276)

Neutron stars can exist with masses between about $0.2M_\odot$ and $1.5M_\odot$, have a radius close to 10 km, and interior densities in the order of 10^{14} g/cm^3. The neutrons are highly degenerate for central temperatures $T_c << 5 \times 10^{11}$° K, and their average Fermi energy is about 50 Mev. The neutrons are in equilibrium with a small amount of protons and electrons, with the Fermi energy level of the electrons approximately equal to the neutron Fermi energy (and small proton Fermi energy). Neutrinos can be emitted by a modified "Urca process" in which two neutrons with suitable momenta "scatter" into a final state of $n + p + e^- + \bar{\nu}$. A table is presented that shows the following emission characteristics for a neutron with mass of $0.5_\odot$ and radius R of 10 km (at four core temperatures): total thermal energy, neutrino loss rate, photon luminosity, surface temperature, cooling time, and optimum wavelength. At short wavelengths ($\lambda \lesssim 1$ A) the rapid fall-off of the neutron star's blackbody spectrum should be easy to distinguish from the flatter spectra expected from other types of X-ray sources. For X-ray wavelengths $\lambda \lesssim 5$ A absorption by interstellar gas is small even across the whole galactic disc. P.V.E.

N64-27405 Aeronautical Research Labs., Melbourne (Australia)
SAFE LIFE ASSESSMENTS FOR PRIVATELY OPERATED MUSTANG AIRCRAFT
D. G. Graff Dec. 1963 31 p refs
(ARL/SM-288)

Safe life estimates using flight data supplied by the Department of Civil Aviation have been made for tank bay failures of two Mustang aircraft. Lives obtained were in excess of 5.0×10^5 hours. Previous service flying could reduce these figures by 50%. Further estimates of the safe life for a representative aircraft following a severe flight plan gave lives in excess of 4.0×10^4 hours. Author

N64-27447 Brandeis U., Waltham, Mass.
THEORETICAL STUDIES IN ASTROPHYSICS Final Report, 1 Jul. 1961–30 Jun. 1964
Jack S. Goldstein 30 Jun. 1964 46 p refs
(Contract AF 19(604)-7283)
(AFCRL-64-572; AD-603281)

Work is reported in the physics of dense media, of radiative transfer, and of stellar associations. The problems in each category may be approached by the methods of the Boltzmann or Liouville equations. The various ways in which energy and momentum may be transported in very dense media were examined. Studies in radiative transfer dealt with solutions to the auxiliary equations for the case of a planetary atmosphere, and with the problems arising in the case of a planetary nebula. G.D.B.

N64-27508* Consultants and Designers, Inc., Arlington, Va.
ON AN ANOMALY IN THE BEHAVIOR OF NH_3 BANDS IN PLANET JUPITER'S SPECTRUM [SUR UNE ANOMALIE DE COMPORTEMENT DES BANDES NH_3 DANS LE SPECTRE DE LA PLANETE JUPITER]
Charles Fehrenbach and Pierre Guérin 16 Jul. 1964 6 p refs Transl. into ENGLISH from C. R. Acad. Sci., Phys. Planétaire (Paris), v. 258, no. 5, 3 Feb. 1964 p 1403–1405
(Contract NAS5-2078)
(NASA-TT-F-8927; ST-LPS-10174)

The inclination of the lines of the NH_3 molecule's λ 6450 band was found to be equal to 50% of the inclination of solar rays. It is therefore concluded that the Spinrad effect was nonexistent in 1963. Author

N64-27614 Ohio State U. Research Foundation, Columbus
STELLAR BACKGROUND MEASUREMENT PROGRAM Semi-Annual Technical Report, 16 Dec. 1963–15 Jun. 1964
Philip E. Barnhart and Walter E. Mitchell, Jr. 3 Jul. 1964 7 p ref
(Contract DA-33-019-AMC-105 Z; ARPA Order 39, Amendment 38; Proj. Defender)
(Rept.-5; AD-442677)

This report contains (1) a summary of all the hand calculations on relative infrared magnitudes so far completed on the extensive data collected in the summers of 1962 and 1963 in Flagstaff, (2) a description of observing runs conducted since the last report period, and (3) equipment modifications directed chiefly at facilitating observations in the 10μ band. Author

N64-27739* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
RADIATIVE EQUILIBRIUM IN PLANETARY ATMOSPHERES. I: APPLICATION OF THE STRONG LINE ABSORPTION LAW TO THE ATMOSPHERE OF VENUS
Rudolf A. Hanel and Frank Bartko Washington, NASA, Aug. 1964 30 p refs
(NASA-TN-D-2397) OTS: $0.75

The interpretation of the data obtained for Venus in the 8μ to 12μ atmospheric window clearly requires some knowledge of the temperature distribution in the planet's upper atmosphere. For this purpose temperatures, net fluxes, and specific intensities were calculated for a CO_2-N_2 atmosphere in radiative equilibrium. The wavelength, temperature, and

pressure dependence of the CO_2 absorption, including the excited bands, was considered. Solar radiation absorbed in the clear atmosphere influences the temperature profile distinctly. The effects of various CO_2 concentrations, cloud-top pressure levels, and cloud reflectivities on the equilibrium temperatures are also discussed. Author

N64-27815* Geophysics Corp. of America, Bedford, Mass.
THEORETICAL ESTIMATES OF THE AVERAGE SURFACE TEMPERATURE ON MARS
George Ohring, Wen Tang, and Gloria De Santo Repr. from J. Atmospheric Sci., v. 19, no. 6, Nov. 1962 p 444–449 refs
(Contract NASw-704)
(GCA-TR-62-3-N)

Estimates of the average surface temperature on Mars are derived from radiative equilibrium considerations. A minimum possible surface temperature is estimated by computing the radiative equilibrium temperature that the Martian surface would have if the planet had no atmosphere. An estimate of the maximum possible value of the average surface temperature is obtained by computing the surface temperature that would result from a maximum greenhouse model. The computations indicate that the average surface temperature is in the range 219° to 233° K. Comparisons of the theoretical computations with indications of surface temperature obtained from thermal emission observations are found to be in reasonable agreement. Author

06 AUXILIARY SYSTEMS

Includes fuel cells and solar cells; gas turbines; hydraulic, pneumatic and electrical control systems and actuators; and inverters. *For primary propulsion systems see*: 27 Propulsion. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-27072 Naval Civil Engineering Lab., Port Hueneme, Calif.
POLAR CONSTRUCTION EQUIPMENT—UNIVERSAL ENGINE-STARTING KIT Final Report
S. E. Gifford 25 May 1964 13 p
(Y-F015-11-01-291; R-311; AD-600440)

This report covers the development and testing of an engine-mounted kit to facilitate starting and operating liquid-cooled engines in low temperatures. The kit was designed to preheat the engine, oil, and battery and to provide ignition assistance during cranking. The components included a gasoline-burning coolant heater, an electric coolant heater, an ether priming system, a battery heating system, and a crankcase shroud. Laboratory tests and field trials show that the kit as a whole was adequate for low-temperature engine starting when using subzero oil for the engine lubricant. However, with a change to 20-weight oil in the mid-1950's, it was found that the kit heaters did not provide sufficient heat for engine starting in temperatures below 0° F. The ether priming system and the battery heating system were useful starting and operating aids for liquid-cooled engines on polar transportation and construction equipment under all conditions. Author

N64-27101 Institute for Defense Analyses, Washington, D.C. Research and Engineering Support Div.
PROCEEDINGS OF THE IDA PULSE-POWER CONFERENCE, FEBRUARY 4–5, 1963, VOLUME IV Study S-104
Jul. 1963 152 p refs Unclassified Papers on Capacitor Energy Storage, Electrochemical Pulse Systems, and Dynamic Pulse Systems
(ARPA SD-50)
(IDA/HQ-63-1415; AD-434752)

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15. ENERGY GENERATION OR LONG DURATION STORAGE BY DYNAMIC METHODS L. A. Kilgore, W. Wright, and C. H. Church (Westinghouse Electric Corp.) p 97–98 (See N64-27115 19-06)
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19. ELECTROMECHANICAL PULSERS E. Levi (Polytechnic Inst. of Brooklyn) p 120–141 refs (See N64-27119 19-06)

N64-27102 General Electric Co., Hudson Falls, N.Y. Capacitor Dept.
FACTORS AFFECTING COST AND SIZE OF CAPACITORS FOR ENERGY STORAGE APPLICATIONS

D. H. Nichols *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 2–18 (See N64-27101 19-06)

The cost and size of a capacitor are shown to depend, in varying degrees, upon voltage, capacitance, type of duty, life required, and inductance. The effect of the specific type of duty, the life requirement, and the inductance of the unit on capacitor cost and size are discussed in detail. R.T.K.

N64-27103 Westinghouse Electric Corp., Pittsburgh, Pa.
CAPACITORS FOR HIGH ENERGY PULSES
Paul Hawkshaw and C. H. Church *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 19–21 refs (See N64-27101 19-06)

Capacitors are usually used to produce high energy, short pulses (less than 1 msec). The energy E stored in a capacitor is $E = 1/2\ CV^2$, where V is the voltage in volts, C is in farads, and E is in joules. As an example of present practice in large capacitor energy-storage facilities, the Westinghouse–McDonnell Hot Shot arc heater is described. It has an energy-storage capacity of 7 megajoules at 12 kv. The capacitors are relatively highly stressed Inerteen-filled units working at 2,200 volts/mil with a life of 5,000 shots. The cost of the capacitor alone is slightly under 5 cents per joule. R.T.K.

N64-27104 Radio Corp. of America, Moorestown, N.J.
HIGH ENERGY FAST PULSE POWER SYSTEM
C. A. Nittrouer *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 22–34 (See N64-27101 10-06)

Various types of energy-storage systems were considered as high-energy power supplies for an exploding wire. The energy range of interest was between 2×10^5 joules and 10^6 joules. The results of the investigation indicated that some form of capacitor system would be required. The total cost of this type of system was estimated to be approximately $1.5 million or $3.00 per joule. R.T.K.

N64-27105 Los Alamos Scientific Lab., N. Mex.
DESIGN CONSIDERATIONS OF MULTIMEGAJOULE CAPACITIVE ENERGY STORAGE SYSTEMS
E. L. Kemp and T. M. Putnam *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 35–46 (See N64-27101 19-06)

The design of multimegajoule banks is felt to be within today's state-of-the-art. There are banks now operating that store five or more megajoules. All capacitor banks contain certain similar components, such as capacitors, racks, switches, transmission systems, charging systems, and protection systems. Each of these components is discussed, with emphasis placed on their applicability to a multimegajoule bank. Most of the present components are felt to be satisfactory for this application, but each requires optimization. R.T.K.

N64-27106 Cosmic, Inc., Washington, D.C.
IMPROVEMENTS IN THE RESISTIVITY OF HIGH DIELECTRIC CONSTANT LIQUIDS
Dominique Gignoux *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 47–49 refs (See N64-27101 19-06)

It was found that when liquids with a relative dielectric constant of 20 to 100 and of sufficiently high resistivity are used as a capacitor dielectric, they provide a proportional increase in the capacitance and a comparable reduction in the size and cost of the capacitor bank. Further development is required, however, to make these liquids practical. Further investigations are needed to find liquids that are capable of high dielectric strength and are also nonflammable. R.T.K.

N64-27107 Avco-Everett Research Lab., Everett, Mass.
BATTERY-OPERATED ARC TUNNEL POWER SUPPLIES
Tom Brogan *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 51–56 (See N64-27101 19-06)

A 10,000-kw electric arc wind tunnel used for reentry studies is described. Its operating duration is 1 minute at 1-hour intervals; the output voltage required by the arcs is 600 v. It has been found that engine-starting batteries, designed for fast discharge, are the most economical form of battery storage for use as a power supply to this battery-operated arc tunnel. R.T.K.

N64-27108 Yardney Electric Corp., New York, N.Y.
SILVER-ZINC SYSTEM FOR 10^{10} JOULE PULSES
Paul L. Howard *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 57–67 (See N64-27101 19-06)

The potential capabilites of the silver oxide–zinc alkaline couple are discussed. The energy stored in the charged plate may be removed at any rate. General figures on estimated size and weight of a system that could give 10^{10} and 10^9 joules for 1 and 2 sec are presented. R.T.K.

N64-27109 Bjorksten Research Labs., Inc., Madison, Wis.
PRINTED BATTERY TECHNIQUES AND RESULTS
D. G. Holinbeck *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 68–71 ref (See N64-27101 19-06)

Most of the work on printed battery techniques was directed toward the development of printed component parts and not the assembly of finished batteries. However, a few batteries were fabricated to demonstrate the performance and possibilities of the plates that were prepared. Test results on one of the batteries are given. With a two-minute activation this battery gave 25 amp at 1.2 v for 120 sec and, in watt-hours per pound, was reported to be 33% better than a standard line high rate battery. This battery was discharged with a cathode current density of 1 amp/in.^{2} but other tests gave equally good results with densities of 1.5 amp/in.^{2}. R.T.K.

N64-27110 Atomic Energy Commission, Germantown, Md.
KAPITZA BATTERIES
Mac Pherson Morgan *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963 Vol. IV Jul. 1963 p 72–75 (See N64-27101 19-06)

Peter L. Kapitza, in 1924, reported having produced a magnetic field of 500 kilogauss for 0.01 sec by employing a bank of four lead-acid storage batteries of the Plante type, which gave 1,000 kw of power. An attempt was made to produce, by means of storage batteries, the maximum energy in a millisecond, with a preliminary goal of corroborating Kapitza's work. Results showed that at a time when two cells were shorted out and external impedance was not matched with internal impedance a pulse equivalent to 3.75 w/cm^2 of active plate area and 244 kw/ft^3 was obtained. This is about 95% of Kapitza's 4w/active cm^2 and 256 kw/ft^3. R.T.K.

N64-27111 Gould-National Batteries, Inc., Minneapolis, Minn.
LEAD ACID BATTERIES
H. E. Zahn *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, vol. IV Jul. 1963 p 76–77 (See N64-27101 19-06)

Using an existing submarine cell now in production, it is estimated that 100,000 amp seconds could be withdrawn per cell at 0.6 average voltage, which is equal to 60,000 joules/cell. Thus for 10^9 joules approximately 16,700 cells would be required. A cell of this type occupies 10.5 ft^3 and weighs 1,660 lbs. Cost of cells only for this requirement is roughly estimated at a total of $20 million. Using the same cell jar as above, preliminary design indications are that the number of plates could be increased from 77 to 113 per cell and a potential capability of 80,000 joules per cell exists. This thinner plate would reduce the number of cells required to approximately 12,000, and the estimated cost is between $25 and $30 million. It is also estimated that an existing commercially produced stationary type of lead-acid cell could produce the required energy, but since each of these cells has an estimated output of 2,600 joules, approximately 390,000 cells would be required at an estimated cost of nearly $60 million. R.T.K.

N64-27112 General Motors Corp., Indianapolis, Ind. Allison Div.
R-Hg LIQUID METAL CELLS
R. E. Henderson *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 78–82 (See N64-27101 19-06)

The liquid metal cell relies on alloy formation between two liquid metals. The basic reaction is presented. A schematic diagram illustrating the operation of the cell is included. This type of cell can be regenerated in a highly efficient manner. Estimates of cell stack weight per kilowatt were made for specific applications. A graph is included that gives stack weight and volume per joule versus pulse time for cell parameters considered usable in 1967. R.T.K.

N64-27113 Hoffman Electronics Corp., El Monte, Calif.
PRELIMINARY REVIEW OF AN AMALGAM FUEL CELL
Joseph S. Smatko *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 83–88 (See N64-27101 19-06)

This paper is a preliminary engineering report of the possibility of using a sodium–bromine fuel cell as an energy source for high pulse power. In this cell the sodium is available in the form of an amalgam of sodium and mercury. The design calculations envision anode-to-cathode separation of 2 mils, using some form of highly porous separator. The anode is to be a plate, covered by a thin layer of sodium amalgam of such concentration as to render it pasty or nearly solid. The cathode considered was of porous, sintered titanium, coated with a minutely thin layer of platinum. For structural reasons, this thin cathode is bonded to a cellular grid, which in turn is bonded to another thin sheet of titanium serving as the anode support for the layer of amalgam on the next cell. Thus, the assembly becomes a bipolar electrode; the assembly of a number of these electrodes is in series to minimize external connections for the large currents. R.T.K.

N64-27114 Westinghouse Electric Corp., Pittsburgh, Pa.
ENERGY AND HIGH PULSE GENERATION
W. Wright and L. A. Kilgore *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 89–96 (See N64-27101 19-06)

Conventional gas turbines and expander gas turbines are considered as high-milliwatt power suppliers. An MHD generator is suggested as a solution to the pulse power energy source that is suited to an off–on type of operation. This type of unit has the advantage that it will not be harmed by sudden load changes. The use of batteries for a pulsed power supply also appears to be feasible. Batteries have the advantage of being readily adaptable to pulsed supplies of various duration and patterns, and require no startup or warmup time; the battery does not lend itself to voltage or current control as well as do the other power supplies that are discussed. R.T.K.

N64-27115 Westinghouse Electric Corp., Pittsburgh, Pa.
ENERGY GENERATION OR LONG DURATION STORAGE BY DYNAMIC METHODS
L. A. Kilgore, W. Wright, and C. H. Church *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 97–98 (See N64-27101 19-06)

A scheme is presented that consists of a multiplicity of large flywheel generator sets that produce the power during the pulse operation from the stored energy in the flywheel. Each individual set would produce about 500 mw for 100 sec, and would slow down from 720 rpm to 360 rpm during the 500-mw 100-sec period. Twenty-two flywheels would be used per generator, with bearings between flywheels. Each flywheel is made up of laminated high-strength steel with a 205-in. diameter and 120-in. in length. Hydraulic turbine generators, such as those used at Niagara Falls, are also described. R.T.K.

N64-27116 Westinghouse Electric Corp., Pittsburgh, Pa.
PROPOSALS FOR THE GENERATION OF HIGH ENERGY PULSES
C. H. Church *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. V Jul. 1963 p 99–100 (See N64-27101 19-06)

The generation of very-high-energy pulses is discussed as to the generation of extremely large amounts of electrical energy, as well as the storage of this electrical energy in a fashion that will provide short pulses to the load of a "rapid access" storage. R.T.K.

N64-27117 General Electric Co., Schenectady, N.Y. Large Steam Turbine-Generator Dept.
SUMMARY OF COMMENTS ON 100,000 KW GAS TURBINE-GENERATOR
C. E. Kilbourne *In* Inst. for Defense Analysis Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 101–104 (See N64-27101 19-06)

The 100,000-kw gas-turbine-generator units are being built for peaking service in electric utility systems. These units are conservatively rated 100,000 kw at 80° F ambient inlet air temperature, and 1,000-ft altitude, when burning liquid jet-aircraft fuel. With ambient temperatures of 20° F, the output can be increased to 125,000 kw. Sixty-cycle/sec a.c. generators are being furnished with these units; however, the gas turbine may also be used to drive large acyclic d.c. generators. A description of the 100,000-kw gas turbine generator and the electric generator is presented along with the advantages of this gas-turbine-generator unit. R.T.K.

N64-27118 Jackson and Moreland, Inc., Washington, D.C.
MOTOR-GENERATORS AND HIGH MAGNETIC FIELDS
C. G. Adams *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 105–119 (See N64-27101 19-06)

The transient overload operating characteristics of motor-generator sets are reviewed. A method whereby the capabilities of the utility system can be used effectively through properly coordinating the characteristics of the motor drive and its excitation control is outlined. Motor-generator sets and control are available that can economically furnish power pulses, up to 4 times their normal continuous rating, for short periods of time. In many locations, utility systems have inherent capabilities that would permit them to supply intermittent loads of

from 20 to 200 megawatts for several seconds, without causing objectionable interference to their service to other customers. Evidence is presented that if these utility system characteristics are fully exploited, a substantial reduction in the cost of pulsed magnet power supplies can result. R.T.K.

N64-27119 Polytechnic Inst. of Brooklyn, N.Y.
ELECTROMECHANICAL PULSERS
Enrico Levi *In* Inst. for Defense Analyses Proc. of the IDA Pulse-Power Conf., Feb. 4–5, 1963, Vol. IV Jul. 1963 p 120–141 refs (See N64-27101 19-06)

Considered is the feasibility of generation of high-energy pulses directly by electromechanical power conversion. Guiding principles are presented for the design of generators with output in the second and μsec pulse-width range, when the materials are pushed to the limit set by the tensile strength. General relations governing the performance of converters employing hot plasmas are established. Author

N64-27121* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A TWIN-GYRO ATTITUDE CONTROL SYSTEM FOR SPACE VEHICLES
Jerry R. Havill and Jack W. Ratcliff Washington, NASA, Aug. 1964 42 p refs
(NASA-TN-D-2419) OTS: $1.00

This report describes the twin-gyro concept and the study of a three-axis attitude control system. Results of experimental data obtained from laboratory tests that used physical components are presented. A twin-gyro controller consists of two counterrotating gyro elements arranged so that control torque is always directed about a single axis independent of gyro gimbal angle. This feature allows the use of large gimbal angles so that a major portion of the momentum stored in the gyros can be transferred to the vehicle without introducing cross-coupling torques. The twin-gyro attitude control system uses three twin-gyro controllers to provide torques about three orthogonal vehicle axes. To study the control system experimentally it was mounted on a space vehicle simulator. The vehicle simulator had large values of inertia and was supported on a low-friction spherical air bearing. The results of the experimental study, which are given in the report, show that a twin-gyro control system can stabilize a vehicle to precise attitudes (within 1 arc second) with good dynamic response. The system transfer function is derived, and a comparison of the measured response with the calculated response shows that the system performance can be predicted analytically. General theoretical equations of motion, derived for a single-degree-of-freedom gyro, a twin-gyro controller, and a three-axis twin-gyro attitude control system, are included. Author

N64-27139 Atomics International, Canoga Park, Calif.
AEROSPACE SAFETY PROGRAM, SNAP 10A REENTRY FLIGHT DEMONSTRATION (RFD-1), ANALYSIS OF FLIGHT-TEST DATA
R. D. Elliott 15 Jul. 1964 57 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9479) OTS: $1.25

A full-scale, nonradioactive model of the SNAP 10A reactor was launched into a suborbital trajectory to obtain data on reentry heating that could be used to predict the mode of disintegration of an actual reactor returning from a satellite orbit. The results of the analysis of data obtained from this flight test are the subject of this report. Author

N64-27175* Stanford U., Calif. Engineering Mechanics Div.
THE OPTIMAL CONTROL OF SOME ATTITUDE CONTROL SYSTEMS FOR DIFFERENT PERFORMANCE CRITERIA
I. Flugge-Lotz and H. Marbach [1963] 10 p refs Repr. from J. Basic Eng., Jun. 1963 p 165–176 Presented at the Joint Autom. Control Conf., ASME, New York, 27–29 Jun. 1962
(Grant NsG-133-61)
(ASME Paper-62-JACC-6)

Optimal control functions in the sense of minimum settling time and minimum fuel or energy consumption are derived from several different single-axis altitude control torque. The torque-producing elements considered include (1) reaction gas jets, with either one or two discrete levels of thrust; (2) an armature-controlled d.c. motor; and (3) a two-phase a.c. motor. Optimal switching curves for these systems are illustrated in the phase plane, and the optimal choice of system parameter values is discussed. Author

N64-27192 Martin Co., Baltimore, Md. Space Systems Div.
CAUSES OF SLOW MALFUNCTIONS, VOL. I
R. J. Novak, J. Burns, and J. E. Clements 15 May 1964 34 p refs
(LV-304, Rev. A; AD-602440)

The purpose of this study is to classify the failure modes and relative probability of occurrence of various malfunctions in the Gemini launch-vehicle flight-control system and associated electrical and hydraulic subsystems. These data will be used in the guidance monitor training program to establish the types of malfunctions that are most likely to happen, and thereby to emphasize these events for training purposes. Included in this effort is the application of actual Titan and Gemini failure-mode results to modify the described theoretical analysis of malfunction probability of occurrence. N.E.A.

N64-27222 Ling-Temco-Vought, Inc., Dallas, Tex. Astronautics Div.
SPACE EXPLORATION BY REMOTE CONTROL
A. M. Mayo Aug. 1964 24 p refs For Presentation at the IAF XVth Intern. Astronautical Congress, Warsaw, 7–12 Sep. 1964
(Rept.-00.487)

Data-gathering systems for space are discussed, and automatic, remotely controlled systems are contrasted with manned systems. The role of man in improving the efficiency of space-flight systems and experiments is reviewed. D.E.W.

N64-27241* Borden Chemical Co., Philadelphia, Pa.
RESEARCH AND DEVELOPMENT OF SEPARATORS FOR SILVER OXIDE-ZINC AND SILVER OXIDE-CADMIUM CELLS FOR SPACECRAFT APPLICATION Third Quarterly Report, 27 Dec. 1963–27 Mar. 1964
H. E. Hoyt and H. L. Pfluger Greenbelt, Md., NASA Goddard Space Flight Center [1964] 40 p refs
(Contract NAS5-3467)
(NASA-CR-57007)

Although cycle life tests on experimental membranes are still in progress several different types have exceeded the life of cellophane or give indication of doing so. Hydroxyethyl cellulose, polyvinyl alcohol, and two of three variant hydroxyethyl polyvinyl alcohol types showed higher capacity than cellophane at the 50 amp discharge rate. Membranes used in the test cells and related compositions were first screened and characterized by tests for conductivity, flexibility, tensile strength, tensile strength in 30% KOH, tensile strength after oxidation of 30% KOH saturated with Ag_2O, and swelling in

30% KOH and 40% KOH. Data of the screening tests are presented. A number of candidates showed low electrical resistances of the order given by cellophane and stability to oxidation running from slightly better in the case of hydroxyethyl polyvinyl alcohols to much better in the case of some of the new candidates upon which life tests are at present unfinished. Author

N64-27253* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE EPE-D TWO YEAR TIMER
T. D. Clem Apr. 1964 22 p
(NASA-TM-X-55019; X-632-64-81) OTS: $2.60 ph

A solid-state timing system used to disconnect the solar cells from the batteries after an interval of two years is described. The basic timing principle is discussed, as well as the circuits used to provide telemetry monitoring of the timing system performance. The circuitry for providing blockhouse testing and monitoring of the system is shown, along with an explanation of the precautions taken to isolate the test circuitry from the actual timing system after testing. Examples and the interpretation of the information received during testing are given. Expected telemetry monitor readout during the complete two-year period is tabulated. Author

N64-27261* National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
ADAPTIVE FLIGHT CONTROL SYSTEMS—PRO AND CON
Lawrence W. Taylor, Jr. and Elmor J. Adkins 15 May 1964 13 p Presented at the AIAA Specialists Meeting, Los Angeles Sect., Los Angeles, 28 Apr. 1964
(NASA-TM-X-56008) OTS: $1.60

This paper discusses the development and operation of the adaptive control system for the X-15 airplane. Several problems encountered during the development of the MH-96 adaptive system were solved on the ground before the first flight, except for some insignificant details that affected only the periphery functions of the MH-96 during the early flights. These problems and their solutions are discussed. R.T.K.

N64-27272* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DYNAMIC SIMULATION OF ST-124 PLATFORM
C. D. Carlile 28 Aug. 1963 17 p refs
(NASA-TM-X-51783; MTP-ASTR-N-63-9) OTS: $1.60 ph

To evaluate the guidance and control loop of the Saturn vehicle before the vehicle is flown, it is necessary to simulate each portion of the hardware. These simulations are then assembled as part of a closed-loop simulation of the overall vehicle. This report covers the portion that has to do with the ST-124 stabilized platform. The ST-124 has four gimbals. Equations are derived that permit the individual gimbal angles of the ST-124 to be studied. These equations are checked by comparing with more conventional equations. The applications of the derived equations as inputs for the guidance and control loop for Saturn are discussed. Author

N64-27317* Moog Servocontrols, Inc., East Aurora, N.Y.
STUDY OF TORQUE MOTOR SIZING FOR USE ON ELECTROHYDRAULIC SERVOVALVES
Roderick F. Bailey Apr. 1964 91 p
(Contract NAS8-5477)
(NASA-CR-56670; MR-845) OTS: $8.60 ph

The reliability of hydraulic servovalves can be improved by increasing the torque output of the servovalve first stage. The optimum-size torque motor required to incorporate a two-stage electrohydraulic servovalve to use with a mechanical feedback actuator is larger than that used on the servovalve of a comparable sized actuator employing electrical feedback. When using larger torque motors to provide greater torque output, increased electrical power input is required; some size and weight penalties result. This study points to some ideal torque-motor sizes. G.D.B.

N64-27328* National Aeronautics and Space Administration, Washington, D.C.
METHOD OF COMPUTING THE SPECIFIC CAPACITY OF FUEL CELLS [METODY RASCHETA UDEL'NOY TOPLIVNYKH ELEMENTOV]
J. S. Daniel'-Bek Aug. 1964 4 p Transl. into ENGLISH from Inzh. Fiz. Zh. (USSR), v. 6, 1963 p 85–87
(NASA-TT-F-9039) OTS: $1.10 ph

Conditions for obtaining maximum specific energy from a fuel cell and the associated supply of active substances are considered. Methods are described for computing the maximum specific energy for cases in which part of the energy is used to generate the active substances. Author

N64-27330 Atomics International, Canoga Park, Calif.
BEHAVIOR OF SNAP 10A DURING ORBITAL REENTRY
D. K. Nelson 15 Jul. 1964 31 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9723) OTS: $0.75

This report presents an analysis of the SNAP 10A power system during orbital reentry to gain information regarding the ablation of various nuclear reactor components. The SNAP 10A power system uses thermoelectric elements to convert the heat developed by a compact nuclear reactor into electrical energy. The initial point in the analysis occurs, after system operation in space, at an altitude in the process of satellite orbit decay where the satellite will not make another complete circuit of the earth. The analysis considered an oblate rotating earth. Results show that the SNAP 10A vehicle has aerodynamic stability with the reactor pointed forward into the airstream, and oscillates about the flight path during reentry. The amplitude and frequency of these oscillations were analyzed with respect to time and altitude for a system with two degrees of freedom. It is shown by the analytical study that the SNAP 10A reactor is ablated to an extent where individual fuel rods are released and subjected directly to aerodynamic heating. The transient heating applied to the reactor system during reentry results in ablation of the forward section of the reactor and adjacent lightweight components at altitudes near 300,000 ft. The heavier components with a greater heat capacity and some parts previously shielded rise in temperature until the reactor separates from the SNAP 10A system. This event is followed by individual fuel element release at about 240,000 ft. Author

N64-27361* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
A POSSIBLE REGENERATIVE, MOLTEN-SALT, THERMOELECTRIC FUEL CELL
Jacob Greenberg, Lawrence H. Thaller, and Donald E. Weber Washington, NASA, Aug. 1964 9 p refs
(NASA-TN-D-2440) OTS: $0.50

Molten or fused salts have been evaluated as possible thermoelectric materials because of the relatively good values of their figures of merit, chemical stability, long liquid range, and ability to operate in conjunction with a nuclear reactor to

produce heat. In general, molten salts are electrolytic conductors; therefore there will be a transport of materials and subsequent decomposition with the passage of an electric current. It is possible nonetheless to overcome this disadvantage by using the decomposition products of the molten-salt electrolyte in a fuel cell. The combination of a thermoelectric converter and a fuel cell would lead to a regenerative system that may be useful. Author

N64-27379 Naval Ammunition Depot, Crane, Ind.
LIFE CYCLE TESTS Monthly Progress Report, Period Ending 31 Mar. 1964
[1964] 81 p
(NASA Order W-11252-B)
(NASA-CR-56478) OTS: $8.10 ph

Life-cycle tests are given in terms of the status of the cycling program, the test parameters, packs still cycling at 50° C, failures, and capacity tests for a space cell test program. The data are presented in tabular form. G.D.B.

N64-27383* Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.
EVALUATION PROGRAM FOR NICKEL CADMIUM SEALED CELLS. LIFE CYCLING TEST First Quarterly Report
J. H. Hettmer 15 Jun. 1964 154 p refs
(NASA Order W-11252-B)
(NASA-CR-58179; QE/C-64-274) OTS: $11.50 ph

The purpose of the cycle life program was to determine the cycling performance capabilities of packs of cells under different load and temperature conditions. The load conditions included cycle lengths of 90 min and 3 hr, and discharge depths of 15% to 40%. The cells were cycled under normal atmospheric conditions at 0°, 25°, 40°, and 50° C. The packs were cycled until more than half of the cells of each pack failed. G.D.B.

N64-27384* General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
CHARACTERIZATION OF NICKEL-CADMIUM ELECTRODES Third Quarterly Report, 1 Jan.–1 Apr. 1964
[1964] 24 p
(Contract NAS5-3477)
(NASA-CR-56625) OTS: $2.60 ph

The main effort consisted of characterization of electrodes, fabrication of test cells, and putting these cells into the various cycling tests. Approximately 55% of the electrodes required have been characterized and fabricated into test cells. An apparatus for determining the gassing characteristics of positive electrodes was constructed, and preliminary data were collected at several charging rates. The blistering of the positive electrodes observed at the 1C rate occurs during the overcharge portion of the cycle. N.E.A.

N64-27389* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Tapco Div.
SUNFLOWER POWER CONVERSION SYSTEM Quarterly Report, Jun.–Aug. 1962
[1962] 29 p
(Sponsored by NASA)
(NASA-CR-58234; ER-5044) OTS: $2.60 ph

Experimental efforts in the development of the solar mercury Rankine system were directed toward defining the system capability for corrosion resistance, hydrogen containment, and lithium hydride containment. Performance testing of the turbo-alternator unit was limited to 2,348 hours because of the corrosion products formed by the test rig. The results indicated that the basic design of the unit was excellent, but that some design modifications should be incorporated in the unit. A tabulation of test results on lithium hydride containment capsules is given, and a description of the optical and vibrational testing of the solar collector is presented. D.S.G.

N64-27396* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio Tapco Div.
SUNFLOWER SOLAR COLLECTOR Topical Report
Sep. 1963 196 p refs
(Contract NAS5-462)
(NASA-CR-56558; ER-5555) OTS: $13.50 ph

This report covers the component development program of the Sunflower solar collector. Analytical investigations of the collector environment and design analysis, and fabrication and inspection techniques are described. Small-scale experimental investigations and developmental and environmental testing of the full-scale 32.2-ft diam collector are described, with the results obtained. The general conclusions of the preprototype development period are delineated, and a prototype development program is recommended. Author

N64-27408 Oak Ridge National Lab., Tenn.
SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP) Literature Search, Jan. 1956–15 Apr. 1964
Henry D. Raleigh, comp. Jun. 1964 75 p refs
(UC-33; TID-3561(Rev.4)) NBS, Springfield, Va.: $1.75

Included are 324 references (with abstracts) to publications on the SNAP program and related nuclear-powered generators. The references cover the period January 1956 through April 15, 1964. Author and report number indexes are included. Author

N64-27422 Atomics International, Canoga Park, Calif.
SNAP 10A REACTOR STRUCTURE
J. D. Sutherland 1 Aug. 1964 33 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-9899) OTS: $0.75

This report describes the design and fabrication of the SNAP 10A reactor structure and presents results of structural analysis and tests of the reactor. Author

N64-27458 Battelle Memorial Inst., Columbus, Ohio
RESEARCH ON A GRAVITY-INDEPENDENT WATER-ELECTROLYSIS CELL WITH A PALLADIUM-SILVER ALLOY CATHODE
John E. Clifford, Edwin S. Kolic, and Charles L. Faust Wright-Patterson AFB, Ohio, AMRL, Jun. 1964 36 p refs
(Contract AF 33(657)-10988)
(AMRL-TDR-34-44; AD-603358) OTS: $2.00

The experimental investigation has demonstrated that a static water electrolysis cell with a palladium–silver alloy hydrogen-diffusion cathode is technically feasible. The best result was obtained with an experimental cell constructed with a 1/4-in.-diam palladium–silver alloy tube of 5-mil wall thickness (0.5-in. effective length), a matrix of Teflon threads, and calcium hydroxide impregnated with an electrolyte of 50 wt % sodium hydroxide, and a platinum screen anode. The cell was operated satisfactorily independently of gravity for a minimum of 24 continuous hours with 97 to 100% hydrogen transmission at 75 amp/ft^2 and 2.0 v at 145° C with water supplied as vapor (1 atm partial pressure). Preliminary design estimates for a cell to supply breathing oxygen for 3 men (6 pounds O_2 per

day) indicate a very small cell (25 pounds, 0.2 ft^3) with low power consumption (760 watts). Author

N64-27519 Air Products and Chemicals Inc., Allentown, Pa. Research and Development Dept.
ENERGY DEPOT CRYOGENIC FUEL STORAGE AND DISTRIBUTION SYSTEM. PHASE I: CONCEPTUAL DESIGN STUDY Final Technical Report, Mar. 15, 1963–May 15, 1964
R. G. Clark, A. Karalis, A. Lapin, H. C. Rowles, and P. D. Stelts Aug. 1964 198 p refs
(Contract AT(30-1)-3129)
(APCI-541301)

The purpose of the energy-depot storage and distribution system is to distribute the fuel from the production depot to the device that converts the fuel into useful energy. The fuel system is designed to provide the following: (1) both long-term and short-term storage of hydrogen delivered from the liquefier; and (2) fuel distribution to and storage at points of use. The development of the liquid-hydrogen storage and distribution system is considered to be entirely feasible. The system will exhibit low specific weight and volume, a high degree of automation, ease of operation, inherent safety, high fluid-storage and transfer efficiency, versatility as to storage time, and reliability. Conceptual design and experimental studies were conducted for a 50-gallon liquid-hydrogen vessel for the energy-depot system. The vessel design involves an inner shell of aluminum alloy, multiple-radiation-shields-and-vacuum insulation, and an outer vacuum jacket of aluminum honeycomb. P.V.E.

N64-27645* Space Technology Labs., Inc., Redondo Beach, Calif.
DECAY RATES OF PASSIVE PRECESSION DAMPERS AND THEIR BOUNDS
Pravin G. Bhuta and Leslie R. Koval N.Y., AIAA [1964] 16 p refs Presented at AIAA/ION Astrodyn. Guidance and Control Conf., Los Angeles, 24–26 Aug. 1964
(Contract NAS1-3400)
(AIAA Paper-64-658) AIAA: $0.50 members, $1.00 nonmembers

The equations of motion for a simple pendulum wobble damper vibrating in a plane containing the spin axis of the space vehicle are derived. Bounds for the decay times are obtained by using the results of a recent theorem by Zajac and are compared, via numerical examples, with the solution of the equation for the energy-sink approximation and with the computer solution of the characteristic equation from the exact linearized equations for the motion of the damper and the parent space vehicle. The energy-sink approximation is treated as an initial value problem and represents an extension over previous solutions in which the transient terms were neglected and only the average value of energy dissipated per cycle was used. The transient terms are found to be of importance for lightly damped systems. The linearized differential equations for the small motion of a spherical pendulum damper are also derived and are shown to reduce to essentially the same equations as those for the simple pendulum damper. The motion corresponding to the additional degree of freedom is an uncoupled free vibration. Author

N64-27731 Magna Corp., Anaheim, Calif. Research and Development Div.
BIOCHEMICAL FUEL CELLS Quarterly Progress Report, 1 Jan.–31 Mar. 1964
J. J. Cavallo [1964] 34 p refs
(Contract DA-36-039-SC-90866)
(QPR-7; AD-602364)

Investigation of the formic acid bioanode using *E. coli* as the biological catalyst was continued. The effect of varying the pH and ionic strength of the supporting anolyte, the number of bacteria, and the addition of methylene blue is reported. Attempts to inhibit the formation of the hydrogenlyase system, which degrades the formic acid, in *E. coli* were largely unsuccessful. However, a new organism, *Pseudomonas formicans*, was substituted. This organism carries out a mixed acid fermentation similar to that of *E. coli*, but is not capable of producing a hydrogenlyase system. Preliminary bioelectrochemical studies with this organism in an integrated cell have produced current densities of 5 ma/cm^2 at a polarization of only 0.25 volt. Author

N64-27769 Gulton Industries, Inc., Metuchen, N.J. Alkaline Battery Div.
LITHIUM-NICKEL HALIDE SECONDARY BATTERY INVESTIGATION Second Quarterly Technical Progress Report
A. E. Lyall and H. N. Seiger 12 Jun. 1964 23 p
(Contract AF 33(615)-1266)
(AD-601148) OTS: $0.75

The work is concerned with electrolyte conductivities, positive and negative electrode preparations, and half cell studies. The half cell studies show that as the $NiCl_2$ (the charged positive material) is reduced to Ni the polarization of this electrode decreases. The polarization of the negative electrode, on the other hand, increases as the electrochemical reaction results in the progressive change of Li into LiCl. The latter can be reduced by the incorporation of a conductive diluent. Author

N64-27790 Thermo Electron Engineering Corp., Waltham, Mass.
THERMIONIC CONVERTER LIFE AND REPEATABILITY INVESTIGATION Second Quarterly Progress Report, 1 Apr.–30 Jun. 1964
C. Z. Kamien [1964] 32 p ref
(Contract AF 33(615)-1348)
(TE-4-65; AD-602285)

Efforts included the fabrication and test of two Series 400 thermionic converters and the fabrication of two additional converters. The testing of converter prototype 401-P-1 yielded an output of 13 w at 0.7 v (6.5 w/cm^2). The results of repairable converter prototype 402-R-1 are 30 w at 0.7 v (15 w/cm^2). The gas-sampling unit has been completed and checked out. The first of four life-test setups has been completed, and the description of the unit is presented. Author

N64-27811* Tennessee U., Knoxville Coll. of Engineering
NONLINEAR ADAPTIVE CONTROL SYSTEMS WITH STORAGE Scientific Report No. 4
Naresh K. Sinha 15 Dec. 1963 22 p refs Previously published as NASA-CR-64; See N64-23031 16-06
(Grant NsG-351)
(NASA-CR-56723) OTS: $2.60 ph

This paper considers adaptive control systems that have nonlinear controllers with storage. Staircase techniques have been used to derive the optimizing equations for calculating the optimum parameters of the compensator for the least mean square error between the actual output and the desired output in terms of the statistical properties of the input signal and the plant dynamics. An example of an input-adaptive system has been calculated showing the superior performance

of a power-series controller with storage over the optimum linear controller, as well as the optimum power-series controller without storage. Author

N64-27818* Naval Ammunition Depot, Crane, Ind.
LIFE CYCLE TESTS Monthly Progress Report
29 Feb. 1964 71 p
(NASA Order W-11252-B)
(NASA-CR-56477) OTS: $7.60 ph

Eighty-six packs are on cycle to date. These include 48 ten-cell packs (nickel cadmium), 2 ten-cell packs (silver cadmium), and 36 five-cell packs (nickel cadmium). Complete data are recorded on each pack every 32nd cycle, and data sheets give the end of discharge- and end of charge-voltage readings for each cell on each cycle recorded. I.v.L.

N64-27828* Thompson Ramo Wooldridge, Inc., Cleveland, Ohio
SUNFLOWER POWER CONVERSION SYSTEM Quarterly Report, Sep. 1–Dec. 1, 1962
[1962] 25 p
(Contract NAS5-462)
(NASA-CR-56206; ER-5163) OTS: $2.60 ph

Progress is reported in the following areas: test rig design and fabrication, power conversion system, solar collector, turboalternator, condensor subcooler, lithium hydride containment, and construction of the workhorse and corrosion loops. R.T.K.

N64-27851 Mallory Battery Co., Tarrytown, N.Y.
TESTING AND EVALUATION OF PRIMARY ALKALINE CELLS AND BATTERIES Seventh Semi-Annual Report, 31 Jul. 1963–31 Jan. 1964
Roger Goodman [1964] 33 p
(Contract DA-36-039-SC-78320)
(Rept.-7; AD-603581)

The cell test program has advanced in the testing and evaluation of primary alkaline cells and batteries of the zinc–alkaline–mercuric oxide system. Delayed discharge test results are presented for cell types 1R at 18 months, 12R at 36 months, 42R at 18 months, 625R at 18 months, 640R at 24 months, 650R at 6 months, 1438R at 12 months, and 1450R at 18 months. Partial data are presented on discharge of cell type 42R at the 1,000-hour rate after 36 months of storage. Author

N64-27863 Textron Electronics, Inc., Sylmar, Calif. Heliotek Div.
HIGH EFFICIENCY SILICON SOLAR CELLS Seventh Quarterly Progress Report, 15 Dec. 1963–15 Mar. 1964
Paul A. Berman 15 Apr. 1964 53 p
(Contract DA-36-039-SC-90777)
(Rept.-7; AD-602759) OTS: $3.00

A polyvariable experiment was performed on P^+/N solar cells to determine the optimum design for performance at solar intensities of about 350 mW/cm^2. The region of maximum response was determined and indicated that a 13-line grid pattern combined with a 12-min diffusion time would give the maximum performance for P^+/N cells operated at solar intensities up to 350 mW/cm^2. A bivariable experiment performed on P^+/N polycrystalline cells showed that polycrystalline cells can be optimized and designed for use in concentrated light systems. The fabrication of cells having from 4 to 8 times the active area of the normal 1 × 2 cm cell indicates that large area cells can be made with short circuit current densities and open circuit voltages that compare quite closely with those obtained from 1 × 2 cm. Investigations were made to determine methods of eliminating the time consuming and relatively expensive junction cleanup etch with a more rapid, less costly process. A number of solar cells were fabricated with the evaporated–sintered-type contact having 5 and 11 grid line patterns and were compared with similar cells having the normal plated contacts. Author

N64-27867 Minneapolis-Honeywell Regulator Co., Hopkins, Minn. Ordnance Div.
LOW INPUT VOLTAGE CONVERSION Final Progress Report, 1 Jul. 1962–29 Feb. 1964
John T. Lingle and Sheldon D. Heaner [1964] 128 p
(Contract DA-36-039-SC-90808)
(AD-600843)

All known methods of low input voltage conversion were examined to determine the optimum and most feasible approach for converting the low source voltage of fuel cells, thermionic diodes, thermoelectric generators, solar cells, and single-cell batteries to a more usable higher voltage. The required transducer parameters for the various approaches were determined. This investigation established that the transistor approach was the most promising for immediate development of low input voltage converters that would have performance characteristics suitable for operation from these energy conversion sources. This approach was enhanced by the development of special low saturation voltage high performance transistors. Performance of initial developmental models verified that current feedback transistor power oscillators should be used because they provide optimum efficiency over the load and ambient temperature range and will operate effectively from the variable voltage of the new energy sources. Development effort determined that the best regulated converter efficiency and system compatibility is achieved by pulse width modulation of the rectified converter output. Author

07 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy); chemical engineering; chemical properties of materials; and synthesis. *For related information see*: 18 Materials, Metallic; 19 Materials, Nonmetallic; and 26 Propellants and Combustion.

N64-27041 Oak Ridge National Lab., Tenn.
PRODUCTION OF TRITIUM BY CONTAINED NUCLEAR EXPLOSIONS IN SALT. II. LABORATORY STUDIES OF THE REDUCTION OF ALKALINE EARTH SULFATES BY HYDROGEN
W. D. Bond Aug. 1964 32 p refs
(Contract W-7405-ENG-26)
(ORNL-3334, Pt. II) OTS: $0.75

The results of this investigation show that tritium produced by a contained nuclear explosion in bedded salt will be mixed with environmental water due to the oxidation-reduction reaction between alkaline earth sulfate impurities and the tritium. The reduction of alkaline earth sulfates with hydrogen occurs in the range of 700° to 900° C at readily measurable rates. Most of the work being reported was performed with

magnesium and calcium sulfates, with only a few experiments being performed with strontium and barium sulfates. Dissolving $CaSO_4$ in molten salt did not lower the temperature for the onset of the reduction nor did it increase its rate. In the presence of excess hydrogen, the solid reduction product of $MgSO_4$ is MgO, whereas with calcium, strontium, or barium sulfates it is mainly the metal sulfide containing a few percent oxide. The experimentally observed reduction products qualitatively agreed with those predicted by thermodynamic calculations. Sulfite was an intermediate in the reductions. A general mechanism is proposed for the high-temperature reduction of sulfates. The proposed mechanism involves reduction of the sulfate to sulfite, with subsequent thermal decomposition of the sulfite. The final products are determined by the reactions among the sulfite decomposition products and by reactions of the reducing gas with the sulfite decomposition products. The solid reduction product and the gaseous products can be predicted from equilibrium data on the thermal decomposition of the sulfite. In developing the mechanism, several possible reactions among the sulfite decomposition products and the reaction of hydrogen with SO_2 were experimentally investigated. Author

N64-27050 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center

α, α-DIPHENYL-β-PICRYLHYDRAZYL AS RADICAL SCAVENGER

Shigeru Kiriyama and Toshiyuki Kasabo 13 Jul. 1964 26 p refs Transl. into ENGLISH from Yuki Gosei Kagaku Kyokai-shi (Japan), v. 15, 1957 p 510–517
(RSIC-214; AD-443431)

Radical scavengers are used to capture radicals formed during the course of a reaction and to enable determinations of radical densities or rates of production. This report deals with the use of α, α-diphenyl-β-picrylhydrazine (DPPH) as a scavenger, and discusses DPPH as follows: (1) its preparation, and physical and chemical properties; (2) its behavior during hydrogen-removal reactions; (3) the chromatographic separation and identification of its derivatives; (4) its use to determine the efficiency of materials used to initiate radical polymerization; (5) its reaction with polymers degraded by ultrasonic waves; (6) its use in verifying that radical fragments are formed when rubber strands are broken during rolling; (7) its reaction with radicals formed by gamma irradiation; and (8) its use in showing the manner in which the exchange reaction between a disulfide and a thiol takes place. It was found that the reactivity of DPPH was considerably affected by solvent type, concentration, oxygen, and reaction temperature. As a result, many problems are associated with its use in the determination of radical densities or reaction mechanisms. Therefore, considerable attention must be paid to reaction conditions when using DPPH as a radical scavenger. I.v.L.

N64-27075 Phillips Petroleum Co., Idaho Falls, Idaho

DEVELOPMENT OF A FLUIDIZED BED CALCINATION PROCESS FOR ALUMINUM NITRATE WASTES IN A TWO-FOOT-SQUARE PILOT PLANT CALCINER. PART IV: FINAL PROCESS STUDIES—RUNS 23 THROUGH 37 Research and Development Report

B. P. Brown, B. M. Legler, and L. T. Lakey Jun. 1964 96 p refs
(Contract AT(10-1)-205)
(IDO-14627) OTS: $2.75

For each run, the objectives, conditions, and results are given. Final testing of the feed nozzle and demonstration of the control of the crystallinity of the product were major objectives of these studies. Factors affecting the generation of elutriatable solids from the calciner were determined. Properties of the fines elutriated from the calciner and additional product properties were also determined. New experimental techniques were developed for control of particle size and for measurement of the rate of growth of particles. Author

N64-27076 Battelle Memorial Inst., Columbus, Ohio

DEVELOPMENT OF HIGH-DIELECTRIC-CONSTANT, LOW-DIELECTRIC-LOSS POLYMERS UTILIZING GAMMA IRRADIATION Topical Report

Manfred Luttinger, Francis A. Sliemers, Jr., John F. Kircher, and Robert I. Leininger 22 Jul. 1964 35 p refs
(Contract W-7405-ENG-92)
(BMI-1678) OTS: $0.75

The polymerization of methyl methacrylate, β-cyanoethyl acrylate, ethyl vinyl sulfone, and β-trifluoroethyl vinyl ether and the copolymerization of β-cyanoethyl acrylate and ethyl vinyl sulfone were investigated for optimum polymer production and purity by radiation and chemical catalytic methods. Dielectric constants and dissipation factors were determined, but no significant difference between the dielectric properties of free-radical polymerized polymers prepared by γ-radiation or by chemical catalysts was discovered. The polymerization of ethyl vinyl sulfone proceeded only with great difficulty, and only moderate yields of low-molecular-weight polymers were obtained. The copolymerization of ethyl vinyl sulfone and β-cyanoethyl acrylate did not improve the yields materially, but resulted in a small increase in molecular weights. Author

N64-27093* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio

ELECTROCHEMICAL OXIDATION OF TITANIUM DIBORIDE

Warren Philipp Washington, NASA, Aug. 1964 8 p refs
(NASA-TN-D-2410) OTS: $0.50

Titanium diboride was anodically dissolved in various electrolytes including hydrochloric acid, perchloric acid, sodium perchlorate, and buffered acetate solution. When not passive, the titanium diboride dissolved stoichiometrically, that is, in a boron to titanium ratio of 2. The boron and titanium were found in solution in the +3 and +4 oxidation states, respectively. Only for the hydrochloric acid electrolyte was the expected current yield of 10 faradays per mole of dissolved TiB_2 observed; for aqueous sulfuric acid, perchloric acid, and sodium perchlorate, the number of faradays was somewhat less. This deficiency in the number of faradays was most prevalent in runs involving relatively strong perchloric acid solutions at high current densities. Author

N64-27129 Joint Publications Research Service, Washington, D.C.

INFRARED SPECTROSCOPY IN JAPAN

6 Jul. 1964 54 p refs Transl. into ENGLISH of selected articles from Kogyo Kagaku Zasshi (Tokyo), v. LXVI, no. 11, Nov. 1963 p 1543–1559
(JPRS-25356; TT-64-31629) OTS: $1.50

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3. INFRARED QUALITATIVE ANALYSIS AND THE COLLECTION OF SPECTRAL DATA S. Shinnosuke (Tokyo Ind. Test Center) p 40–53 (See N64-27132 19-07)

N64-27130 Joint Publications Research Service, Washington, D.C.
THE APPLICATION OF THE INFRARED ABSORPTION SPECTROSCOPY TO CHEMICAL INDUSTRY A Symposium
Umezawa Sumio and Oi Naobumi *In its* Infrared Spectroscopy in Japan 6 Jul. 1964 p 1–19 refs (See N64-27129 19-07) OTS: $1.50

Progress in the development of infrared absorption spectroscopy is reviewed. The utilization of infrared and extreme infrared absorption spectroscopy, the measurement of minute and microsamples, the solubility of solid samples, the utilization of attenuated total reflection spectroscopy, and the infrared absorption of inorganic compounds, are discussed. R.T.K.

N64-27131 Joint Publications Research Service, Washington, D.C.
THE PROBLEMATIC POINTS IN THE INFRARED ABSORPTION SPECTROSCOPIC ANALYTIC METHOD
Tanaka Seishi (Tokyo U.) *In its* Infrared Spectroscopy in Japan 6 Jul. 1964 p 20–39 refs (See N64-27129 19-07) OTS: $1.50

The infrared absorption spectroscopic method is discussed as follows: (1) limits of application, (2) its relations to qualitative and quantitative analysis, (3) various problems in the use of the infrared gas analytic meters as an automatic continuous analytic method, (4) the problems in expanding the method for use in the near infrared and extreme infrared ranges, and (5) the interrelationship of the infrared method to other instrumental methods of analysis. R.T.K.

N64-27132 Joint Publications Research Service, Washington, D.C.
INFRARED QUALITATIVE ANALYSIS AND THE COLLECTION OF SPECTRAL DATA
Saheki Shinnosuke (Tokyo Ind. Test Center) *In its* Infrared Spectroscopy in Japan 6 Jul. 1964 p 40–53 (See N64-27129 19-07) OTS: $1.50

The following data collection systems that can be used in the qualitative analysis of data from infrared absorption spectrometers are discussed: (1) the file- and dictionary-type index systems, (2) edge-notched punched cards, (3) combined use of IBM cards and statistical machines, (4) the magnetic tape method, and (5) peep hole card storage of data. R.T.K.

N64-27141 Vanderbilt U., Nashville, Tenn.
INTERPRETATION OF NEAR AND VACUUM ULTRAVIOLET BAND SPECTRA Final Technical Report, 1 Jun. 1963–31 May 1964
K. Keith Innes [1964] 6 p refs
(Grant DA-ARO(D)-31-124-G456; ARPA Order 40)
(AROD-005-12; AD-442208)

The spectra of a BF_3 vapor discharge were studied between 5,600 A and 6,000 A, and it was found that the emitting molecule contains only one atom each of boron and oxygen and two atoms of fluorine. Therefore, the BOF_2 molecule must be the emitter. The spectrum of the boron–chlorine molecule has been studied at high resolution in the vacuum ultraviolet region. Spectroscopic investigations of other molecules (AlO, MgS, BS_2, and BO_2) are reported. D.E.W.

N64-27207 Industrial Science and Technology Agency, Tokyo (Japan) Electrotechnical Lab.
STUDY OF INDUSTRIAL ION EXCHANGE PURIFICATION OF RARE EARTH COMPOUNDS BY EDTA-COPPER METHOD
Keijiro Nishigori Dec. 1963 110 p refs in JAPANESE; ENGLISH Summary *Its* Res. of the Electrotech. Lab. no. 648

An ion exchange equipment is manufactured for trial based on experimental results of purification of rare-earth compounds by means of a small column. Lanthanum and cerium compounds are purified with this equipment. Using the experimental results, an industrial ion exchange equipment was designed. It has 20 ion exchange towers of strong acid type resin, each tower being 400*l* in capacity, and is capable of purifying 200-kg lanthanum compounds as oxides. Ion exchange separation of cerium and yttrium earth compound was also studied. Monazite sand and xenotime ore are treated by using the fractional precipitation fractional crystallization and TBP solvent extraction to be separated into several fractional parts. Ion exchange purification is put in practice using these fractional parts. All the earth oxides except europium are obtained with purities higher than 99%. By reference to the above-mentioned experimental results of ion exchange, a method was devised for industrial ion exchange purification of rare-earth compounds, including fractional precipitation, fractional crystallization, TBP solvent extraction, and decomposition of monazite sand and xenotime 1. Author

N64-27229* National Aeronautics and Space Administration, Washington, D.C.
THE EFFECTS OF GAMMA-IRRADIATION ON POLYETHYLENE TEREPHTHALATE
Hiroshi Sobue and Atsusuke Kajiura (Tokyo U.) Jul. 1964 17 p Repr. from Kogyo Kagaku Zasshi (Tokyo), v. 62, no. 12, 1959 p 1908–1911
(NASA-TT-F-9008)

The products from the irradiation of polyethylene terephthalate with γ-rays under various conditions have been examined by mass spectrometry, infrared absorption spectra viscosity measurement, and X-ray diffraction; the results are compared with those for heating under vacuum and β-ray irradiation. Doses of 84 to 960 megarad were used. Author

N64-27245* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SILANE POLYMERS OF DIOLS
James E. Curry and James D. Byrd 6 Apr. 1964 30 p refs
(NASA-TM-X-53028) OTS: $2.60 ph

The purpose of this study was to synthesize and develop a new class of polymers that have improved physical and chemical properties. Polymers that have useful properties and very good thermal stability were prepared by combining the thermally stable aromatic rings with the silicon polymer chain. The polymer showing the best properties is polydiphenylsiloxybiphenyl, which is stable to 600° C (1,112° F) for short periods of time. It is also reasonably stable when exposed to ultraviolet radiation, has good fiber- and film-forming properties, and is a good adhesive at ambient temperatures. Author

N64-27292* Avco-Everett Research Lab., Everett, Mass.
NONEQUILIBRIUM SHOCK FRONT ROTATIONAL, VIBRATIONAL AND ELECTRONIC TEMPERATURE MEASUREMENTS Research Note 398
R. A. Allen Jul. 1964 26 p refs
(Contract NASw-748)
(NASA-CR-58036) OTS: $2.60 ph

A spectroscopic technique is described for measuring nonequilibrium shock front rotational, vibrational, and electronic temperatures. This method uses a triple channel monochromator

that is able to resolve the vibrational structure of diatomic molecular radiation, and a monitor channel to observe an electronic transition composed of many vibrational transitions. Measurements are made on incident nitrogen shock waves by observing the $\Delta v = +1$ sequence of the $N_2^+(1-)$ and $N_2(1+)$ systems. As well as giving nonequilibrium temperature results, this experiment gave equilibrium radiation intensities indicating an f number at the 0.0 transition of 0.035. Author

N64-27302* IIT Research Inst., Chicago, Ill.
RADIATIVE ENERGY TRANSFER ON ENTRY INTO MARS AND VENUS Quarterly Report No. 7
William O. Davies Jun. 1964 32 p refs
(Contract NASr-65(01))
(NASA-CR-56537; IITRI-T200-7) OTS: $3.60 ph

The dissociation rate of CO_2 was measured for temperatures of 6,000° to 11,000° K. The rate of disappearance of CO_2 behind shock waves in a CO_2-Ar gas mixture was monitored by observing the infrared radiation from the CO_2 2.7μ combination bands. The dissociation rates were expressed in the classical collision theory and an Arrhenius equation (in cm^3/particles-sec). A rate constant was also determined from observations of emission at 3,500 A, which is proportional to the product of the CO and O concentrations. The rates determined from these measurements are about a factor of three lower than those obtained from the infrared measurements, and the process has an activation energy of 3.68 ev as compared to the 2.96 ev for the infrared measurements. These results suggest that two different reactions are being observed; it is suggested that the infrared observations are a measure of CO_2 dissociation, while the UV emission is controlled by the recombination of CO and O into an excited state of CO_2, and the radiative lifetime of this CO_2 level. The results obtained by both methods over a temperature range of 2,600° to 10,000° K are summarized. Author

N64-27382* General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
DEVELOPMENT OF NEUTRON ACTIVATION ANALYSIS PROCEDURES FOR THE DETERMINATION OF OXYGEN IN POTASSIUM Third Quarterly Report, Period Ending Mar. 31, 1964
E. L. Steele 19 Jun. 1964 19 p refs
(Contract NAS3-2537)
(NASA-CR-54099; GA-5339) OTS: $1.60 ph

The development of neutron-activation analysis procedures for the determination of oxygen in potassium has been continued. The principal effort has been devoted to improvements in the equipment. Particular attention was given to the problem of neutron monitoring during irradiation. All manual operations, including transfer, timing, analyzer starts and stops, accelerator on and off, and neutron-flux determinations, were eliminated by an automatic control mechanism that steps the system through the entire procedure. A new device was designed and installed to insure a more uniform sample irradiation. Further development work was done on sample handling and encapsulation. Various metals and alloys were examined for residual oxygen content, and several cleaning techniques were investigated. Improvements were made in the detection system. A new detector that measures the high-energy beta particles from *N* rather than gamma rays was also investigated. N.E.A.

N64-27417* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GUANINE: FORMATION DURING THE THERMAL POLYMERIZATION OF AMINO ACIDS
Cyril Ponnamperuma, Richard S. Young, Elaine F. Munoz, and Barbara K. Mc Caw Repr. from Science, v. 143, no. 3613, 27 Mar. 1964 p 1449–1450 refs
(NASA-RP-283)

An experimental investigation was conducted to determine whether certain nucleic acids could be formed during the thermal polymerization of amino acids. This would provide a possible abiological pathway for the synthesis of purines and pyrimidines. The proteinoid was prepared according to the method of Fox. Thin-layer chromatography and paper chromatography were used for the analysis. Guanine was detected, which is thought to be a significant result in terms of chemical evolution. A possible mechanism for the formation of guanine is briefly considered. IAA

N64-27459 Air Products and Chemicals, Inc., Allentown, Pa.
INVESTIGATION OF THE PARA-ORTHO SHIFT OF HYDROGEN Final Report, Nov. 1962–Nov. 1963
E. G. Biskis, J. F. Kucirka, and G. E. Schmavch Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Mar. 1964 104 p refs
(Contract AF 33(657)-10333)
(APL-TDR-64-48; AD-603150) OTS: $4.00

This report presents the results of a program for the development of catalysts for the promotion of the low-temperature para-ortho reaction of hydrogen. This program has resulted in the preparation and testing of a catalyst with an activity 13.7 times greater on a weight basis than the best commercial material. Detailed mechanism studies resulted in a model for the conversion reaction that successfully predicts the kinetic behavior over a wide range of flow rate, pressure, and catalyst particle size. Catalyst poisoning studies have further elucidated the reaction mechanism, and indicate a rate reduction probably due to the blocking of the mouths of the catalyst pores. Author

N64-27470 Aerospace Corp., El Segundo, Calif. Material Sciences Lab.
MERCURY PHOTOSENSITIZED OXIDATION OF TETRAFLUOROETHYLENE
Julian Heicklen, Vester Knight, and S. A. Greene 15 Jul. 1964 30 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-106; TDR-269(4240-20)-4; AD-603344)

The mercury photosensitized reactions of C_2F_4 were studied in the absence and the presence of oxygen at room temperature. In the absence of oxygen, the only product was cyclo-C_3F_6, whereas CF_2O and another unidentified product were also formed in the presence of oxygen. The cyclo-C_3F_6 formation rate was unaffected by oxygen or nitrogen and was proportional to the C_2F_4 pressure and the square root of the incident intensity. The results are explained. The oxidation apparently does not involve the CF_2 radical. Two processes are introduced to explain the oxygenated products. One of these is attack of C_2F_4 by oxygen atoms produced from the mercury photosensitized decomposition of oxygen. The other involves the reaction of molecular oxygen with an electronically excited C_2F_4 molecule. Author

N64-27495 Royal Inst. of Tech., Stockholm (Sweden)
DISSOCIATION OF ETHANE MOLECULE IONS FORMED IN CHARGE EXCHANGE COLLISIONS WITH POSITIVE IONS. ION-MOLECULE REACTIONS OF ETHANE Technical Report
H. Von Koch 30 Apr. 1964 32 p refs
(Grant AF-EOR-63-68)
(AFCRL-64-578; AD-603037)

Mass spectra of ethanes (C_2D_6, C_2H_6, and CH_3CD_3) were obtained after charge exchange with slow positive ions. The intensities of the peaks were plotted as a function of the energy absorbed by the molecule during the charge exchange. Integration of these curves gives a mass spectrum in reasonable agreement with that obtained in electron impact. The most interesting of the ion-molecule reactions observed at low velocity of the incident ion is $COH^+ + C_2D_6 \rightarrow C_2D_6H^+ + CO$. The way in which the ion formed dissociates indicates that the ionized carbon in this intermediate ion must be considered as having the valency five with all bonds of approximately equal strengths. Author

N64-27527 Iowa State U. of Science and Tech., Ames Ames Lab.
A FINITE DIFFERENCE MODEL OF THE PULSE COLUMN
Stanley B. Collins and L. E. Burkhart Jul. 1963 38 p refs
(Contract W-7405-ENG-82)
(IS-849) OTS: $1.00

Equations for a stagewise model of the pulse column were developed using the approach of Burkhart and Fahien. The model represents operation of the column in the mixer-settler region at steady state. Linear equilibrium lines, nonequilibrium contact, zero organic recycle, and equal holdup in all stages were assumed for the analysis. The resulting set of equations was solved using finite difference calculus. A closed-form general solution resulted. The general solution was programed for digital computer evaluation because of the complex nature of the expressions required for the evaluation of the arbitrary constants in the general solution. The model predicted performances close to those obtained experimentally by Burkhart and Fahien. Author

N64-27530 Moleculon Research Corp., Cambridge, Mass.
SYNTHESIS AND ELECTRICAL PROPERTIES OF BENZIMIDAZOLES AND HETEROCYCLIC QUINONOID COMPOUNDS Final Report, Apr. 1963–Mar. 1964
A. S. Obermayer, L. D. Nichols, M. Panar, C. E. Hannaver, A. H. Teich et al 30 Apr. 1964 58 p refs
(Contract AF 19(628)-2940)
(AFCRL-64-359; AD-603276)

The synthesis and purification are described for a number of organic derivatives of benzimidazoles, 2,1,3-thiazoles, 2, 1, 3-selendiazoles, oxazines, and fused ring quinones. The electrical properties of these compounds have been investigated by dark conduction, photoconduction, and pulse photoconduction techniques. Author

N64-27535 Royal Inst. of Tech., Stockholm (Sweden)
DISSOCIATION OF METHANE MOLECULE IONS FORMED IN CHARGE EXCHANGE COLLISIONS WITH POSITIVE IONS. ION-MOLECULE REACTIONS OF METHANE Technical Note No. 1
H. Von Koch 6 Apr. 1964 21 p refs
(Grant AF-EOAR-63-68)
(AFCRL-64-545; AD-603091)

Mass spectra of methanes (CH_4 and CD_4) have been obtained after charge exchange with slow positive ions. The intensities of the peaks have been plotted as a function of the energy absorbed by the molecule during the charge exchange. Integration of these curves gives a mass spectrum in reasonable agreement with that obtained in electron impact. The complete dissociation of the parent ion above 15 ev throws some doubt upon the determination of the higher ionization potential of methane from the break at 19.4 ev of the ionization efficiency curve for the production of the parent ion. The ion–molecule reaction $CH_4^+ + CD_4 \rightarrow CH_3 + CD_2H^+ + D_2$ indicates that in CH_5^+ all bonds are of approximately equal strength. Author

N64-27567 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
KINETICS OF THE $H_2/CO/O_2$ SYSTEM
W. E. Kaskan and W. G. Browne Jul. 1964 29 p refs
(Contract AF 04(694)-222)
(R64SD37; AD-224971)

A literature search has been conducted for kinetic data on the more important chemical reactions that occur in the $H_2/CO/O_2$ system. Twenty-one reactions involving eleven different chemical species were considered. In some cases, no kinetic data have been reported, and in others the literature data are fragmentary and incomplete. Kinetic data are recommended for the primary reactions in both the forward and backward directions; also the influence of various third bodies for recombination reactions is assessed. Author

N64-27591 Canada Dept. of Mines and Tech. Surveys, Ottawa
SPECTROGRAPHIC AND NEWER METHODS OF IMPURITY ANALYSIS IN REFRACTORY METHODS
A. H. Gillieson *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 381–393 refs (See N64-27576 19-18) Pergamon: £7

For the interstitial impurities hydrogen, oxygen, nitrogen, and carbon, vacuum fusion is adequate for hydrogen and oxygen, and nitrogen and carbon are determined satisfactorily down to about 10 ppm by the classical methods of Kjeldahl distillation and of combustion, respectively. The determination of the general substitutional impurities is being adequately performed by d.c. arc methods, employing controlled atmospheres or stabilization of the arc by the Stallwood air-jet. Spectrophotometric methods of high sensitivity and precision have been developed for a few elemental impurities. Author

N64-27592 Compagnie de Produits Chimiques et Electrometallurgiques, Paris (France)
THE ANALYSIS OF REFRACTORY METALS FOR IMPURITIES
R. Orsage *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 395–398 (See N64-27576 19-18) Pergamon: £7

Methods for analyses of oxygen, hydrogen, carbon, nitrogen, and iron are presented that are the simplest and require the least equipment. G.D.B.

N64-27612 Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
A STUDY OF THE ADSORPTION MECHANISMS ON OXYGEN ELECTRODES Final Report, 6 Sep. 1962–5 Mar. 1964
Y. L. Sandler and S. Z. Beer 29 Jan. 1963 85 p refs
(Contract DA-36-039-AMC-00136(E); ARPA Order-226)
(Rept.-4; AD-442413)

The various types of oxygen chemisorption in different temperature ranges are investigated mainly on silver, also on silver–gold alloys, platinum and palladium. Pressure-temperature scans, various types of isotopic oxygen exchange reactions, desorption rates, and the magnetic-ortho-para-conversion of adsorbed hydrogen are used as tools. Presence of firmly bound oxygen changed the reversibility of the oxygen adsorption and also raised the electrode potential at room temperature. Author

N64-27613 Oklahoma U. Research Inst., Norman
THE EFFECT OF SOLID STATE DISLOCATIONS UPON THE CATALYTIC ACTIVITY OF METALS Final Report
T. D. Perkins, C. M. Sliepcevich, and W. R. Upthegrove 1 Mar. 1963 115 p refs
(Contract Nonr-982(08))
(AD-400749)

This report discusses the effect of dislocations upon catalytic activity. The dislocation density, superficial surface area, microscopic surface area, and mass of a silver catalyst were measured, and the (211) plane of the metal subsequently used to catalyze the decomposition of formic acid. Dislocation densities were varied by deforming plastically the metallic catalyst and ranged from 10^6 to upward of 10^8 line intersections per square centimeter. Decomposition rates for the formic acid reaction were measured over a temperature range of 165° to 190° C and a pressure range of 20 to 70 mm of mercury. The effect of different dislocation densities upon catalytic activity was related to the change in hydrogen overpotential. Author

N64-27623 Tyco Labs., Inc., Waltham, Mass.
ELECTROCHEMISTRY OF FUEL CELL ELECTRODES. HYDROGEN EVOLUTION AT A SOLID INDIUM ELECTRODE
James N. Butler and Manfred Dienst
(Contract Nonr-3765(00); ARPA Order 302-62)
(TM-11; AD-440751)

Measurements of hydrogen overvoltage on solid indium electrodes were made in 0.1 molar $HClO_4$ at temperatures from 21° to 59.5° C. The slow step in the hydrogen evolution reaction is probably discharge of a hydrogen ion, as indicated by the exchange current (10^{-11} amp/cm^2), transfer coefficient (0.5), effect of added iodide ion, and effect of acid concentration. The enthalpy of activation is 14.1 ± 0.5 kcal/mole at the reversible hydrogen potential and 10.0 ± 0.2 kcal/mole at the zero-charge point. From these values, an estimate of 50 ± 10 kcal/g atom was obtained for the heat of adsorption of hydrogen atoms on indium. The reaction was very sensitive to traces of oxygen. The formation and removal of oxide films is discussed. Author

N64-27638 Joint Publications Research Service, Washington, D.C.
TECHNICAL EXPLOITATION OF ELECTROCHEMICAL PHENOMENA UNDER SEAWATER CONDITIONS
A. A. Farkhadov and S. A. Alibeyli 21 Aug. 1964 11 p refs Transl. into ENGLISH from Tr. Vsesoyuznaya Mezhvuz. Nauchn. Konf. Po Voprosam Bor'by S Korroziyey (Baku), 1962 p 220–225
(JPRS-26067; TT-64-41337)

By use of electrochemistry to separate out from seawater and deposit on a cathode the insoluble carbonate salts, it is possible to protect pilings of marine structures in the zone of periodic washing; to prevent scale formation on surfaces of piping (cooling structures) and compressor cylinders at petroleum administrations; and to prevent (or to remove) overgrowth by crustaceans, barnacles, etc. on pilings of marine structures and ships. Author

N64-27677 Quantum, Inc., Wallingford, Conn.
HIGH TEMPERATURE POLAMINE RESINS Technical Progress Report, 15 Mar.–15 Jun. 1964
Raymond L. Taylor [1964] 24 p refs
(Contract NObs-90266)
(TPR-1; AD-441429)

A literature search was conducted to investigate work that has been done with aromatic amine–organic chloride reactions and organosodium amide preparations from amines and amides. Polymers were made from α,α′-dichloro-p-xylylene and diamines of various molecular structures. Polymers with varying characteristics can be made from these materials. Polymers that are essentially linear in structure but of relative low molecular weight have been synthesized by the diamine–dichloride route. Extensive investigations of polyamine synthesis from sodium salts of amides and amines, and chlorides have been and are still being conducted. Author

N64-27721 Humble Oil and Refining Co., Baytown, Tex.
A HIGH PRESSURE MASS SPECTROMETRIC STUDY OF NEOPENTANE
M. J. Henchman (Leeds U.), H. T. Otwinowska, and F. H. Field Charlottesville, Va. U., Jul. 1964 36 p refs Presented at the Mass Spectrometry Conf., Paris, Sep. 1964 Submitted for Publication
(Contract Nonr-3623(00); Proj. Squid)
(HUM-5-P; AD-603314)

A modified A.E.I. Metropolitan–Vickers MS-2 mass spectrometer was used to investigate the ion–molecule reactions occurring at high pressures in neopentane. The extent of these reactions is appreciably smaller than those observed in the lighter alkanes. No ions with mass greater than the parent mass of neopentane (m/e = 72) are observed. Essentially the only product ions observed at EV = 70 volts are m/e = 43 ($C_3H_7^+$) and m/e = 71 ($C_5H_{11}^+$) with maximum relative intensities of 0.090 and 0.070, respectively. The rate constants for the formation of these ions are $k_{43} = 15 \times 10^{-10}$, and $k_{71} = 16 \times 10^{-10}$ cc/mol sec. From appearance potentials it is concluded that at threshold the product ions are formed from $C_3H_5^+$ and/or $C_2H_5^+$. The pressure plots indicate that m/e = 15 (CH_3^+), m/e = 27($C_2H_3^+$), and m/e = 29($C_2H_5^+$) reacts and m/e = 39($C_3H_3^+$) and m/e = 41($C_3H_5^+$) react and are formed. Rate constants were obtained for the three reactant ions: $k_{15} = 13 \times 10^{-10}$, $k_{27} = 5 \times 10^{-10}$, and $k_{29} = 8 \times 10^{-10}$ cc/mol sec. Mass spectra of neopentane were obtained at low values of the ionizing voltage (EV = 9 to 14 volts). Author

N64-27748 Union Carbide Research Inst., Tarrytown, N.Y.
FLUORINE OXIDIZERS Quarterly Technical Summary Report, 1 Mar.–1 Jun. 1964
R. Didchenko and R. H. Toeniskoetter [1964] 17 p refs
(Contract DA-31-124-ARO(D)-77; ARPA Order-402)
(QTSR-4; AD-441620)

A quantitative determination of cathodic and anodic yields of bromine and bromine pentafluoride from electrolysis of $KBrF_4$-BrF_3 solution was made. The volatile cathodic products were obtained in the ratio $BrF_5/Br_2 = 1.9$, where the ratio was 3.4 for the anodic products. The Faraday yields were 30% and 19% for cathodic and anodic processes, respectively. An experiment for glow discharge was carried out in anhydrous HF at −78° C using ClO_3F as sparge gas. A second experiment was conducted without sparge gas. Both experiments give the same results—the presence of HF and ClO_3F, and only a trace of a substance believed to be CO_2. A.W.

N64-27750 Union Carbide Plastics Co., Bound Brook, N.J. Research and Development Dept.
RESEARCH ON IMPROVED EPOXY RESINS
W. P. Mulvaney, R. F. Sellers, and S. G. Smith 1 May 1964 30 p
(Contract NONr-4172(00)-(X))
(QPR-4; AD-600067)

A discussion of the relationship of physical properties to molecular configuration and to the relative purity of representative sample resins is presented, as interpreted from cast resin data. Progress is described on the continued evaluation of various novel epoxy molecular structures and modifications thereto. Author

N64-27773 Texaco Experiment Inc., Richmond, Va.
INVESTIGATION OF THE DISSOCIATION CHEMISTRY OF $-NF_2$ COMPOUNDS Quarterly Report, May–Jul. 1964
U. V. Henderson, P. L. Goodfriend, and H. P. Woods 6 Aug. 1964 5 p refs
(EXP-452(223); TM-1562)

The search was continued for the electronic-absorption spectrum of the NF radical that is produced by flash photolysis of NF_2. A cell that heats the samples to 180° C was constructed; however, the use of this has not solved the problem of excessive N_2F_4 absorption. Consideration has been given to alternative approaches to the problem. Author

N64-27775 Centre National de la Recherche Scientifique, Paris (France)
THE PERTURBATION OF SPECTRAL FREQUENCIES BY SOLID MATRICES Final Technical Report, 11 Apr. 1963–1 Apr. 1964
B. Vodar [1964] 27 p refs
(Contract DA-91-591-EUC-2882)
(AD-601539)

The program of work on the perturbation of spectral frequencies by solid matrices in the vacuum ultraviolet is an extension of the observations of pressure effects on spectral lines under various high pressures of foreign gas. In this difficult region, the absorption spectra of atoms in the ultraviolet were successfully studied—first, the relatively simple mercury whose resonance lines lie at 2,537 A and 1,850 A, then the more difficult cases of xenon with its lines at 1,469 A and 1,296 A, and finally, krypton with its lines at 1,236 A and 1,165 A. The complete spectra of xenon and of krypton both in the pure state and in rare gas matrices were studied, using the direct absorption spectrum technique. In the case of mercury in a matrix of argon at liquid hydrogen temperature, three bands were observed, located at 2,480, 2,062, and 1,793 A and in a matrix of isopentane at 2,560, 2,180, and 1,890 A. Author

N64-27796* National Bureau of Standards, Washington, D.C.
OBSERVATION OF FeO IN ABSORPTION BY FLASH HEATING AND KINETIC SPECTROSCOPY
Arnold M. Bass, N. A. Kuebler (Bell Telephone Labs.), and L. S. Nelson (Sandia Lab.) Repr. from J. Chem. Phys., v. 40, no. 10, 15 May 1964 p 3121–3122 refs
(NASA Order R-64)

In extending the study of the emission spectrum of the diatomic oxide FeO, several new ways to produce the spectrum in absorption were recently examined. This article concerns the use of flash heating and kinetic spectroscopy for the excitation of the orange system A- and B-bands of FeO in absorption, as well as a diffuse absorption feature in the 2,410- to 2,430-A region during the direct reaction of metallic iron with gaseous oxygen. G.D.B.

N64-27820* Houston U., Tex.
STUDIES IN EXPERIMENTAL ORGANIC COSMOCHEMISTRY
J. Oro Repr. from Ann. of the N.Y. Acad. of Sci., v. 108, Jun. 1963 p 464–481 refs
(Grants NsG-257-62; NSF-G-13117)

Experimental studies are presented suggesting that if the earth protoplanet had some of the simple organic constituents of comets, a large number of biochemical compounds (including carbohydrates, amino acids, purines, pyrimidines, and polymers containing amino acids) would have been spontaneously synthesized during the development of this cosmic body. The formation of complex biochemical compounds from simple organic molecules is not in disagreement with thermodynamic principles. In fact, these syntheses can occur because the initial precursors (nitriles, aldehydes, olefins, etc.) are compounds of high-energy content, which, in their tendency to acquire lower energy states and to become stabilized, react and are transformed into biochemical compounds. The possibility that organic chemical synthesis may have occurred in interstellar dust and planetesimal bodies before the earth was formed is also suggested. Author

N64-27823 Vanderbuilt U., Nashville, Tenn.
THE EFFECT OF COORDINATION ON THE REACTIVITY OF ARCMATIC LIGANDS Progress Report, Period Ending Mar. 31, 1964
Mark M. Jones, Naresh K. Chawla, and Ronald C. Mc Nutt [1964] 7 p
(Grant DA-ARO(D)-31-124-G490)
(PR-8; AD-602522)

Research efforts are reported in the following areas: the development of electrostatic models for ligand reactions; kinetic studies of the mercuration of 8-hydroxyquinoline and its copper (II) complex; and the polarographic study of the complexes of 5-nitrosalicylaldehyde. R.T.K.

N64-27830* National Bureau of Standards, Washington, D.C.
PYROLYSIS OF NEW FLUOROPOLYMERS
S. Straus and L. A. Wall Repr. from Soc. Plastic Engrs. Trans., v. 4, no. 1, Jan. 1964 refs Previously Published as N63-12806 06-07
(NASA Order R-56)

Four new fluoropolymers were pyrolyzed in the temperature range of 230° to 380° C to study rates of volatilization in percent per minute, and at higher temperatures, up to 500° C, to determine the volatile decomposition products. The following polymers were studied: polyperfluoropropylene, polyperfluoroheptene, poly-4-chloroperfluoroheptadiene-1,6, and poly(1,2,2-trifluorovinyl phenyl ether). R.T.K.

N64-27842 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
HYDROLYSIS OF ORGANOCHLOROSILANES IN A CONTINUOUS COUNTERFLOW SPRAY COLUMN
T. G. Pavlenko, K. A. Andrianov et al 29 Apr. 1964 13 p refs Transl. into ENGLISH from Izvest. Vyssh. Ucheb. Zaved., Khim. i Khim. Tekhnol. (Moscow), v. 6, no. 3, 1963 p 465–470
(FTD-TT-64-132/1+2+4; AD-600789)

The process of hydrolysis of certain organochlorosilanes was investigated and revealed the possibility for carrying out hydrolysis in a continuous counterflow spray column. The application of the continuous counterflow method led to the production of a polymer that was not qualitatively inferior to the one received by the discontinuous method in a mixing-type apparatus. The plastic prepared on the basis of the polymer showed good physicomechanical properties. Author

08 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; telemetry; tracking; and wave propagation. *For tracking stations see*: 10 Facilities, Research and Support. *For related information see*: 06 Auxiliary Systems; 09 Electronics; 15 Instrumentation and Photography; and 22 Navigation and Guidance.

N64-26976 Michigan U., Ann Arbor Coll. of Engineering
STUDIES IN RADAR CROSS SECTIONS XLIX—DIFFRACTION AND SCATTERING BY REGULAR BODIES. III: THE PROLATE SPHEROID
F. B. Sleator Feb. 1964 235 p refs
(Contract AF 19(604)-6655)
(Rept.-3648-6-T; AFCRL-64-138; AD-603033)

This report on electromagnetic and acoustical scattering by prolate spheroids is divided into three sections. Section I deals with a discussion of the methods and principles employed in the various solutions, with emphasis on exact wave-function solutions. The mathematical background—spheroidal geometry and spheroidal functions are discussed. Scalar solutions are derived, and a formulation is given for the solution of an electromagnetic-scattering problem in terms of a set of vector wave functions analogous to those developed for the sphere problem by Hansen. Section II deals with approximate solutions of the wave functions. Frequency-restricted approximations, eccentricity-restricted approximations, and approximations for weak scatter are derived. Section II also contains the tabulation of formulas pertaining to exact scalar solutions, and axial dipole solution, a general vector solution, Rayleigh series, variational forms, geometrical and physical optics, a modified geometrical theory, asymptotic solutions, the uniform field result, the traveling wave, the perturbations of a sphere solution, and weak scatterers. Section III contains the graphical representation of Section II as well as the experimental findings. I.v.L.

N64-27042 Joint Publications Research Service, Washington, D.C.
ON THE USE OF CYBERNETIC TEACHING MACHINES
Nadhezhda Konstantinova-Antonova 13 Aug. 1964 16 p refs Transl. into ENGLISH from Narodna prosveta (Sofia), no. 6, Jun. 1964 p 64–74
(JPRS-25893; TT-64-41164) OTS: $1.00

A description is given of teaching machines with self-adjustment, self-improvement, and feedback controls. The machines are made for different functions in the science of cybernetics—to present to the students definite teaching material, to evaluate the student's knowledge, and to increase the effectiveness of the teacher–student information exchange. The machines' designs follow the principles of computers, containing an input and an output unit, a memory, and a control unit. A.L.B.

N64-27052 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
A CONTRIBUTION TO THE THEORY OF THE PARAMETRIC SINGLE-DIODE AMPLIFIER WITH ONE AUXILIARY CIRCUIT AND TWO DRIVING STAGES
Hermann Mahr 13 Jul. 1964 19 p refs Transl. into ENGLISH from NTZ-Nachrtech. Z. (Brunswick), no. 12, 1963 p 630–634
(KSIC-217; AD-443434)

Equations are given to explain the energy input from a power source and the energy needed for parametric single-diode amplifiers with one auxiliary circuit and two driving stages. To balance the energy in the system, an auxiliary circuit must absorb energy at a frequency equal to the difference between driving frequency and signal frequency. The energy conversion between the driving and signal frequencies is accomplished by using a nonlinear capacitor. Equations were derived to show the bandwidth and the noise characteristics of the nonlinear capacitor measurements of the energy driving and the signal frequency. A.L.B.

N64-27064 Joint Publications Research Service, Washington, D.C.
RADIO COMMUNICATIONS WITH SPACE ROCKETS
E. Yu. Yur'yev 11 Aug. 1964 85 p refs Transl. into ENGLISH of the book "Radiosvyaz' s Kosmicheskimi Raketami" Moscow, Oborongiz, 1963 p 1–80
(JPRS-25847; TT-64-41118) OTS: $3.00

Attention is centered on the problems of radio communications from a spacecraft back to the earth. Discussed are the following: (1) characteristics of radio-communications lines with space objects; (2) the wavelength range of space radio communications; (3) methods of radio-signal reception and transmission; (4) onboard radio equipment of space rockets; (5) basic units of ground equipment for communications with space objects; and (6) the radio-communications system of the Pioneer-IV. N.E.A.

N64-27065 Joint Publications Research Service, Washington, D.C.
NOISE IMMUNITY OF COMMUNICATIONS SYSTEMS WITH ERROR CORRECTING FEEDBACK [POMEKHOUSTOYCHIVOST' SISTEM SVYAZI s PERESPROSOM]
11 Aug. 1964 217 p refs Transl. into ENGLISH from Problemy Peredachi Inform. (Moscow), no. 13 [1963] p 1–172
(JPRS-25853; TT-64-41124) OTS: $6.00

The purpose of the present work is systematic discussion of the possibility of fundamental results relative to the investigation of systems with feedback from unique procedural positions. Main attention is given to a detailed investigation of systems with constant parameters in which a feedback channel is considered to be free of noise and is used for transmission from the receiver to the transmitter of signals, indicating either the necessity for repetition of transmission of an element of communication recognized as unreliable or the necessity for continuing transmission of the next elements of communication. Several problems are investigated that refer to systems with variable parameters; also, measures for the prevention of noise influences in the feedback channel are investigated. Author

N64-27099 Shape Air Defense Technical Center, The Hague (Netherlands)
DETERMINATION OF THE ACCURACY OF ROUTINE PROPAGATION MEASUREMENTS ON THE ACE HIGH SYSTEM
I. Vogt Jan. 1964 26 p ref
(ITM-90; AD-440390)

Routine propagation measurements are being carried out by station personnel on most of the ACE High troposcatter links. In these measurements the automatic-gain-control voltage is recorded on a paper recorder, and the median values for 15-min periods are scaled from the recordings. The accuracy of these measurements was checked on one link. The results obtained over a period of 10 days show that the 15-min median values are scaled very accurately, but that errors of up to 12.5 db are introduced by inaccurate calibrations. Author

N64-27144 Colorado U., Boulder
PROPAGATION IN NON-UNIFORM WAVEGUIDES WITH IMPEDANCE WALLS

Robert Gallawa 1 May 1964 91 p refs
(Contract NBS-CST-7348; ARPA Order-183-62)
(AD-440499)

Subjects include the vector eigenfunction problem, orthogonality conditions, the parallel-plate waveguide, forward and backward traveling waves, and surface impedance. D.E.W.

N64-27151 Joint Publications Research Service, Washington, D.C.
IZVESTIYA VUZov: RADIOPHYSICS, NO. 1, 1964
19 Jun. 1964 283 p refs Transl. into ENGLISH of Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. VII, no. 1, Jan.–Feb. 1964 p 1–188
(JPRS-25168; OTS-64-31520) OTS: $4.00

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2. PRECISION MEASUREMENTS OF THE RADIO EMISSION FROM THE MOON AND THE SUN IN THE 4mm WAVELENGTH BAND A. G. Kislyakov and V. M. Plechkov p 64–72 refs (See N64-27153 19-05)

3. CONCERNING THE DETECTION OF WATER IN THE ATMOSPHERE OF VENUS I. Ye. Salomonovich p 73–85 refs (See N64-27154 19-05)

4. COMPLEX DIELECTRIC CONSTANT OF A MAGNETOACTIVE PLASMA AT LOW FREQUENCIES S. B. Biragov p 86–97 refs (See N64-27155 19-24)

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6. PASSAGE OF ION BEAMS THROUGH A PLASMA V. B. Krasovitskiy and K. N. Stepanov p 122–137 refs (See N64-27157 19-24)

7. ON THE THEORY OF INTERACTION OF WAVES IN A PLASMA I. A. Daneliya and N. L. Tsintsadze p 138–146 refs (See N64-27158 19-24)

8. ALLOWANCE FOR SHADOWS IN THE SCATTERING OF WAVES BY A STATISTICALLY UNEVEN SURFACE F. G. Bass and I. M. Fuks p 147–164 refs (See N64-27159 19-08)

9. FLUCTUATIONS IN PERIODICALLY NONSTATIONARY SYSTEMS V. N. Lugovoy p 165–180 refs (See N64-27160 19-24)

10. TWO DIMENSIONAL ELECTROMAGNETIC FIELDS GUIDED BY PLASMA LAYERS I. G. Kondrat'yev and M. A. Miller p 181–197 refs (See N64-27161 19-24)

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12. CONTRIBUTION TO THE ANALYSIS OF PROCESSES IN A MULTICAVITY MAGNETRON V. Ye. Nechayev p 215–235 refs (See N64-27163 19-09)

13. APPROXIMATE DETERMINATION OF PERIODIC MOTIONS IN A SYSTEM OF AUTOMATIC PHASE CONTROL OF FREQUENCY R. A. Peskov p 236–243 refs (See N64-27164 19-09)

14. REDUCTION IN THE NUMBER OF TRIALS WHEN SOLVING SOME PROBLEMS OF THE SYNTHESIS OF DISCRETE AUTOMATA A. D. Zakrevskiy p 244–256 refs (See N64-27165 19-20)

15. EFFECTIVE HEIGHT OF ABSORPTION OF RADIO WAVES OF THE CENTIMETER BAND IN ATMOSPHERIC OXYGEN AND WATER VAPOR V. V. Kuzovlev and K. S. Stankevich p 257–259 refs (See N64-27166 19-08)

16. FIELD STRUCTURE INSIDE A PLASMA LAYER WITH ZERO PERMITTIVITY I. G. Kondrat'yev and M. A. Miller p 260–265 refs (See N64-27167 19-24)

17. RADIATION OF LONGITUDINAL WAVES IN MEDIA WITH WEAK SPATIAL DISPERSIONS M. L. Levin p 266–268 refs (See N64-27168 19-24)

18. LINE STRENGTH IN MAGNETIC-DIPOLE TRANSITION IN THE HYPERFINE STRUCTURE OF THE ATOM V. M. Kontorovich and G. Ye. Chernyak p 269–273 refs (See N64-27169 19-05)

19. CONCERNING PROTECTIVE COATINGS FOR CELLS WITH ALKALI ELEMENT VAPORS V. F. Zolin p 274 refs (See N64-27170 19-19)

N64-27152 Joint Publications Research Service, Washington, D.C.
QUANTUM PARAMAGNETIC AMPLIFIERS
I. V. Karlov and A. A. Manenkov *In its* Izv. VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 1–63 refs (See N64-27151 19-08) OTS: $4.00

The physical principles of quantum amplifiers are described. The media for quantum amplifiers are crystals with impure paramagnetic ions; these are discussed. The properties of quantum amplifiers for the radio band are given, as well as the construction of the amplifiers. Discussed in detail are applications in a transcontinental communication line through outer space. The paper concludes with an examination of the prospects for development of quantum amplifiers for the radio band. G.D.B.

N64-27159 Joint Publications Research Service, Washington, D.C.
ALLOWANCE FOR SHADOWS IN THE SCATTERING OF WAVES BY A STATISTICALLY UNEVEN SURFACE
F. G. Bass and I. M. Fuks *In its* Izv. VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 147–164 refs (See N64-27151 19-08) OTS: $4.00

The reflection of sound waves from a statistically uneven surface in the presence of shadows is considered in the Kirchhoff approximation. Formulas are obtained for the reflection coefficient and for the average intensity of the scattered field. The results are valid also in the case of the scattering of electromagnetic waves. Author

N64-27166 Joint Publications Research Service, Washington, D.C.
EFFECTIVE HEIGHT OF ABSORPTION OF RADIO WAVES OF THE CENTIMETER BAND IN ATMOSPHERIC OXYGEN AND WATER VAPOR
V. V. Kuzovlev and K. S. Stankevich *In its* Izv. VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 257–259 refs (see N64-27151 19-08) OTS: $4.00

In investigating the absorption of radio waves in the atmosphere by radioastronomical methods, the total absorption along the line of sight is measured; this brief paper suggests an effective method measurement. G.D.B.

N64-27172 Gt. Brit. Ministry of Aviation, London Technical Information and Library Services
A WIDE-BAND ABSORBER FOR ELECTROMAGNETIC WAVES [BREITBANDABSORBER FUR ELEKTROMAGNETISCHE WELLEN]
J. Deutsch and P. Thust Apr. 1964 7 p refs Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), v. 11, no. 12 1959 p 453–455
(TIL-T-5381)

The construction and reflection factor measurements of shaft absorbers are described, which are suitable for meter waves. The depth of these absorbers is at most one-third of the longest wave to be absorbed with a reflection factor of 10%. Within the useful relative bandwidth of 1:35, the reflection factor is less than 10%. For waves with a slanting incidence, the reflection factor for the limit wavelength is less than 10% over an angular range of 35°. With rising frequency, the permissible angle of incidence rapidly increases to > 65° Author

N64-27252* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EXPERIMENT—TIME SYNCHRONIZATION OF REMOTE STATIONS USING SYNCOM SATELLITE
Raymond L. Granata, Peter D. Engles, and Paul F. Mc Caul Jan. 1964 6 p
(NASA-TM-X-55016; X-531-64-7) OTS: $1.10 ph

The accurate transfer of time between two remote stations is discussed. The transfer of corrected Universal Time, UT-2 time, from one Syncom station to a remote Syncom station was accomplished with the aid of Goddard Range and Range Rate equipments. The proposed system will be capable of achieving time synchronization to an accuracy of 0.5 microsecond or less. Included in this experiment is a method of verifying the time synchronization, measuring the system uncertainty, and maintaining accurate synchronization. The experiment was divided into two phases: (1) the transfer and maintenance of time from the United States Naval Observatory to the master station; and (2) the transfer and maintenance of time between the two Syncom ground stations, via the Syncom satellite. The time synchronization was accomplished by the use of a portable clock that was transferred between the stations in question. A.L.B.

N64-27254* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A NARROW-BAND TRACKING FILTER
Ronald Woodman 17 Jan. 1964 12 p Suppl. to NASA-TN-D-1419
(NASA-TM-X-55020; NASA-TN-D-1419; X-531-64-9) OTS: $1.60 ph

The characteristics of a servo phase-lock tracking filter are described. The filter tracks a 100-cps carrier with a bandwidth of either 0.3 cps or 0.03 cps. The advantages of this type filter and its use are also discussed. Author

N64-27258* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE TRACKING AND DATA ACQUISITION NETWORK FACILITIES REPORT (STADAN)
Jun. 1964 162 p
(NASA-TM-X-55026; X-539-64-159) OTS: $12.00 ph

The Minitrack system is described as to purpose, tracking function, and data-acquisition function. Data-acquisition facilities are described, as is the Goddard Range and Range-Rate System. The spacecraft operations facility is discussed; technical operating procedures are outlined; an analysis of network coverage is given; major capabilities are summarized; and the geodetic locations of stations are listed. D.E.W.

N64-27259* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HANDBOOK OF ANTENNAS AT NASA SATELLITE TRACKING AND SPACE DATA ACQUISITION NETWORK (STADAN) FACILITIES. VOL. II
Paul A. Lantz Jul. 1964 152 p ref
(NASA-TM-X-55031; X-525-64-168) OTS: $11.50 ph

The following are discussed: paraboloidal antennas, command elements for 85-foot paraboloids, antenna arrays, Goddard Range and range-rate antenna system, OGO special-command antennas, AMR prelaunch monitoring antennas, Tiros data-acquisition antennas, Explorer XV data-acquisition antenna, advanced-technological-satellite ground antennas, sounding-rocket ground antennas, and Apollo ground-based antennas. R.T.K.

N64-27267 Michigan U., Ann Arbor Radio Science Lab.
SURVEY AND ANALYSIS OF LONG-DISTANCE COMMUNICATION TECHNIQUES Final Report
George W. Mc Clure and John C. Duté May 1964 109 p refs
(Contract FAA/ARDS-487)
(RD-64-7; Rept.-4978-15-F)

Various means of providing a reliable communication system for air traffic control in the North Atlantic in the 1970's have been investigated. The study indicates that considerable improvement in the adequacy and reliability of communication with over-ocean aircraft (during the interim period before 1970) could be obtained by the adoption of an optimized hybrid system utilizing high frequencies (in both ground wave and ionospheric modes); very high frequencies (present communication band in both line-of-sight and tropospheric scatter modes); and low frequencies (ground-to-air). However, the study also indicates that the only economically and operationally feasible technique that will fully satisfy the near-future requirements for communication to over-ocean aircraft and that will be at all adequate for post-1970 requirements is one that utilizes active satellite relays. The study further indicates that, for the communication function alone, synchronous (or 24-hour period) satellite orbits are superior to other orbits when economics and operational procedures are considered. Author

N64-27299* Resdel Engineering Corp., Pasadena, Calif.
ANTENNA TEST TRANSMITTERS Final Report
Bertrand M. Ward, Jr. Apr. 1964 6 p
(Contract NAS8-11546)
(NASA-CR-56938) OTS: $1.60 ph

This report describes efforts made on the design, development, and manufacture of the UDOP antenna test transmitter, the 2,000- to 2,300-mac antenna test transmitter, and the VHF antenna test transmitter. G.D.B.

N64-27308* ITT Federal Labs., San Fernando, Calif. Astrionics Center
AROD VEHICLE TRACKING RECEIVER Final Report and Instruction Manual
Apr. 1964 157 p
(Contract NAS8-5483)
(NASA-CR-56951) OTS: $11.50 ph

This document covers the final report and instruction manual for the "Brassboard" model of the AROD (Airborne Range and Orbit Determination) vehicle-tracking receiver. The purpose of this receiver is to demonstrate the feasibility of the AROD system by airplane flight testing. A brief description of the entire AROD system is included; and the function and operation of each module in the receiver are discussed in detail. R.T.K.

N64-27332 New York Academy of Sciences, N.Y.
LARGE STEERABLE RADIO ANTENNAS—CLIMATOLOGICAL AND AERODYNAMIC CONSIDERATIONS
Harold E. Whipple (ed.) and Edward Cohen (consulting ed.) 26 Jun. 1964 358 p refs *Its* Ann., v. 116, Art. 1 Papers presented at a conf., N.Y., 4–6 Sep. 1963

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2. RADIO ASTRONOMY J. W. Findlay (Natl. Radio Astron. Obs.) p 5–9 refs

3. TRACKING CONSIDERATIONS FOR LARGE STEERABLE RADIO ANTENNAS J. H. Trexler (Naval Res. Lab.) p 10–12 ref

4. THE BENELUX CROSS ANTENNA PROJECT B. G. Hooghoudt (Leiden U. Obs.) p 13–24 refs

5. OPERATING EXPERIENCE AT THE NATIONAL RADIO ASTRONOMY OBSERVATORY J. W. Findlay p 25–40 refs

6. EXISTING AND PROPOSED INSTALLATIONS J. Feld p 41–61 refs

7. CONSTRUCTION AND OPERATION OF THE 210-FOOT RADIO TELESCOPE AT PARKES, AUSTRALIA M. H. Jeffery (Freeman, Fox and Partners, London) p 62–89 refs

8. PREDICTION OF DESIGN AND OPERATING WIND VELOCITIES FOR LARGE STEERABLE RADIO ANTENNAS H. C. S. Thom (Weather Bur.) p 90–100 refs

9. WIND VELOCITY PROFILES A. K. Blackadar (Pa. State U.) p 101–115 refs

10. WIND GUST SPECTRA I. A. Singer (Brookhaven Natl. Lab.) p 116–134 refs

11. THE BUFFETING OF LARGE SUPERFICIAL STRUCTURES BY ATMOSPHERIC TURBULENCE A. G. Davenport (Western Ontario U.) p 135–160 refs

12. CALCULATION OF WIND FORCES AND PRESSURES ON ANTENNAS E. Cohen, J. Vellozzi (Ammann and Whitney), and S. S. Suh (Grumman Aircraft Eng. Corp.) p 161–221 refs

13. THE AERODYNAMICS OF SHALLOW PARABOLOID ANTENNAS T. A. Wyatt (Imperial Coll., London) p 222–238 refs

14. WIND TUNNEL TESTING OF ANTENNA MODELS R. B. Blaylock, B. Dayman, Jr., and N. L. Fox (JPL) p 239–274 refs (See N64-27333 19-08)

15. A BRIEF REVIEW OF WIND EFFECTS ON RADIO PARABOLOIDAL REFLECTOR INSTALLATIONS WITH SPECIAL REFERENCE TO THE WIND-EXCITED VIBRATIONS OF THE MEMBERS OF THE SUPPORTING STRUCTURE C. Scruton (Natl. Phys. Lab., Teddington) p 275–286 refs

16. CRITERIA FOR DESIGN AGAINST WIND-INDUCED VIBRATIONS IN ANTENNA MEMBERS W. Weaver, Jr. (Stanford U.) p 287–310 refs

17. DYNAMIC STABILITY AND AEROELASTIC CONSIDERATIONS IN THE DESIGN OF LARGE STEERABLE ANTENNAS F. H. Hull (N. Am. Aviation) p 311–323 refs

18. THE IMPACT OF CLIMATOLOGICAL EFFECTS ON THE STRUCTURAL DESIGN H. Rothman (Ammann and Whitney) p 324–335

19. CONTROL SYSTEMS AND DRIVES W. S. Smoot p 336–338

20. ENGINEERING CONSIDERATIONS TO OBTAIN AN OPERATIONAL SYSTEM W. J. Bobisch (Bur. of Yards and Docks) p 339–344

21. OBTAINING RESEARCH FACILITIES IN THE AIR FORCE B. G. Holzman (AFCRL) p 345–352

N64-27333* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

WIND TUNNEL TESTING OF ANTENNA MODELS

R. B. Blaylock, B. Dayman, Jr., and N. L. Fox *In* N.Y. Acad. of Sci. Large Steerable Radio Antennas–Climatol. and Aerodyn. Considerations 26 Jun. 1964 p 259–274 refs (See N64-27332 19-08)

(Contract NAS7-100)

The Northrop 7- × 10-ft subsonic wind tunnel was chosen as the facility in which to perform the antenna windload tests. The 18-in.-diam paraboloidal reflectors were mounted by a 1 5/8-in.-diam steel rod to the balance located beneath the tunnel floor. A knuckle, located immediately behind the center of the reflector, permitted manually set elevation angles from 0° to 180° in 5° increments. The supporting rod was enclosed by, but did not touch, a 2-in. external diameter tubular windshield. This windshield virtually eliminated the windloads on the supporting rod. The results obtained were discussed from the following aspects: (1) typical force and moment data; (2) the effect of the center of the rotation position; (3) the effect of Reynolds number; (4) the effect of reflector depth; (5) the effect of reflector surface porosity; (6) the effect of spoilers; (7) the effect of reflector surface support structure; (8) support and ground plane interference; (9) the effect on windloads of nonuniform wind velocity profiles; (10) quadripod loads; (11) the synthesis of parametric data for a complete configuration; and (12) pressure distribution measurements. I.v.L.

N64-27390* Hughes Research Labs., Malibu, Calif.

PRELIMINARY STUDY OF MODULATION SYSTEMS FOR SATELLITE COMMUNICATION

S. Plotkin Jun. 1963 63 p refs

(Contract NASw-495)

(NASA-CR-56538; Rept.-6R) OTS: $6.60

A comparative study of power and bandwidth requirements for SSB, FM, and PCM modulation systems is given as related to multiple-access satellite communications. Composite power loading factors for multichannel speech are treated as a function of the number of channels. Actual system requirements for each of the three systems are then given with respect to an assumed reference application. Multiple-access considerations show that serious difficulties arise in both all-FM and all-PCM systems. Thus the concluding modulation system choice is SSB for the up link, and wideband FM for the down link. It was further concluded that frequency division multiplex is preferable to time division multiplex. A theoretical comparison of the three modulation systems is derived that compares the peak transmitter power requirements as well as bandwidth. Results are then used to show the relative power requirements of equal bandwidth FM and PCM systems as a function of output S/N ratio. Author

N64-27426 Technical Research Group, Inc., Melville, N.Y.

HETERODYNE DETECTION IN OPTICAL COMMUNICATION Final Report

S. F. Jacobs, J. T. La Tourrette, G. Gould, and P. Rabinowitz Griffiss AFB, N.Y., RADC, Jul. 1964 236 p refs

(Contract AF 30(602)-2591)

(RADC-TDR-64-130; AD-603622) OTS: $7.00

The properties of optical heterodyne detection are analyzed and measured, using a laser and Twyman–Green interferometer. It is shown that heterodyne amplification preserves the signal-to-noise ratio in the detected difference frequency in the presence of incoherent noise and that the limiting noise of the system is photocurrent shot noise. Suitability of this technique is demonstrated for diffuse as well as specular mirrors and corner reflectors as well as flats. Various techniques of modulation are discussed and demonstrated, including phase, amplitude, and single-sideband modulation. A method is developed for the demodulation of phase-modulated light. The limitations

imposed on the optical heterodyne technique by the transmission path conditions are investigated. The uses and limitations of heterodyne detection in optical communications, demultiplexing of channels, demodulation of FM and AM, doppler and displacement measurements, and laser stabilization are discussed. Author

N64-27427 Pennsylvania U., Philadelphia
STUDY AND INVESTIGATION OF POLARIZATION PROGRAMMING. POLARIZATION SYSTEMS ANALYSIS Final Report
R. S. Berkowitz, J. Choder, R. G. Mulholland, and P. Hahn Griffis AFB, N.Y., RADC, Aug. 1964 52 p refs Prepared under Subcontract to Am. Electron. Labs.
(Contract AF 30(602)-3105)
(RADC-TDR-64-258, vol. II; AD-603624)

Three systems are proposed for utilization of polarization programing in a ground-to-ground, over-the-horizon, tropospheric-scatter-propagation communications link. These are instantaneous polarization programing, orthogonal-mode polarization programing, and rapid polarization programing. It is shown that all three systems are theoretically feasible and can lead to significant increases in signal-to-interference ratios achievable. A detailed description and evaluation of each system is presented, based on the assumptions of slowly varying polarization of an interfering signal and nondepolarization of desired signal by the propagation medium. Comparisons are presented of the relative utility of the three systems as well as their relation to present communication systems. Author

N64-27438 Air Force Cambridge Research Labs., Bedford, Mass.
ON THE OPTIMUM DESIGN OF MULTIPATH SIGNALS
Neil J. Bershad Jun. 1964 17 p refs *Its* Phys. Sci. Res. Papers no. 22
(AFCRL-64-485; AD-603591)

The problem of designing optimum signals for transmission through gaussian time-varying multipath media is investigated. The signals are constrained to be band-limited, as are the time variations of the multipath media. The results of this report indicate that varying the transmitted signal has only limited effect on the statistics of the received signal and, hence, on the error probabilities. Author

N64-27477 Electromagnetic Research Corp., College Park, Md.
A STUDY OF METEOROLOGICAL PHENOMENA AS RELATED TO THE ERRORS IN RADIO INTERFEROMETER TRACKING SYSTEMS, PART I Scientific Report no. 1
D. L. Ringwalt 15 Jun. 1964 63 p refs
(Contract AF 19(628)-2818)
(CRL-2818-1; AFCRL-64-587, Pt. 1; AD-603510)

Meteorological parameters are responsible for certain errors in radio-interferometer-type tracking systems. This report considers these tracking errors as being a combination of "bias" and "noise" errors. Bias errors are defined as having periods greater than several minutes, whereas noise errors are defined as having periods ranging from about a second to several minutes. Ground-based and airborne meteorological instrumentation for the measurement of the appropriate meteorological parameters is described. Data acquisition, reduction, and analysis procedures for the determination of both bias and noise errors are described. Author

N64-27478 Electromagnetic Research Corp., College Park, Md.
A STUDY OF METEOROLOGICAL PHENOMENA AS RELATED TO THE ERRORS IN RADIO INTERFEROMETER TRACKING SYSTEMS, PART 2 Scientific Report No. 1
D. L. Ringwalt 15 Jun. 1964 125 p
(Contract AF 19(628)-2818)
(CRL-2818-1; AFCRL-64-587, Pt. 2; AD-603511)

This is a photographic and chart presentation of meteorological phenomena as related to the errors in radio interferometer tracking systems. Refractive index variations, amplitude distribution of refractive index, power spectra of refractive index, distribution of radio-wave delays, and aircraft-speed run data are among the aspects covered. G.D.B.

N64-27502 Joint Publications Research Service, Washington, D.C.
SOVIET CALCULATING AND COMMUNICATIONS EQUIPMENT
N. I. Shchedrin, comp. 10 Jul. 1964 97 p refs Transl. into ENGLISH of "Sredstva Mekhaniz. Inzh. i Administrativno-Upravlencheskogo Tr." Moscow, State Sci. Res. Inst., 1963 p 1–95
(JPRS-25435; TT-64-31708) OTS: $2.25

This compilation contains a short description of Soviet digital computers, analog computers, machines for centralized monitoring and control, duplicators and multipliers, designing and drafting equipment, and administrative and managerial equipment. G.D.B.

N64-27507* National Aeronautics and Space Administration, Washington, D.C.
RECEPTION AND INVESTIGATION OF THE PROPERTIES OF RADIO SIGNALS FROM SOVIET SPACE ROCKETS [PRIYEM I ISSLEDOVANIYE OSOBENNOSTEY RADIOSIGNALOV SOVETSKIKH KOSMICHESKIKH RAKET]
V. A. Kotel'nikov, V. M. Dubrovin, O. N. Rzhiga, and A. M. Shakhovskoy Aug. 1964 13 p ref Transl. into ENGLISH from Iskusstv. Sputniki Zemli (Moscow), no. 17, 1963 p 91–100
(NASA-TT-F-8531)

This paper deals with the result of observations of the radio signals from the three Soviet space rockets launched toward the moon in 1959. The equipment used for simultaneous reception and registration of 20- and 40-mc signals is described. Observations of radio signals from the rockets are discussed. Brief mention is made of the hard landing of the payload capsule of the second rocket. Observation of the Faraday effect was made; signal fading was caused by capsule rotation. G.D.B.

N64-27525 Southwest Research Inst., San Antonio, Tex.
AN EXPERIMENTAL BEVERAGE ANTENNA ARRAY FOR LAND BASED DIRECTION FINDING BETWEEN 1.5 AND 30 MC Third Quarterly Progress Report, 1 Jan.–31 Mar. 1964
Paul E. Martin, Douglas N. Travers, M. Pike Castles, and Richard Lorenz 31 Mar. 1964 49 p refs
(Contract DA-36-039-AMC-02346(E))
(Rept.-3; AD-443093)

Theoretical pattern studies were continued to investigate Beverage antenna performance as a function of angle-of-elevation, frequency, array radii and ground constants. A recent comparison of theoretical and experimental patterns showed

that the mathematical model of the Beverage antenna may be accepted with confidence. No significant reduction in pattern beamwidths by linear summation of antenna inputs is predicted when the radius of the points of summation is small compared to a wavelength. The effect of poor ground conductivity indicates that reasonable performance of the frequency band of 2 to 32 mc will require that the element lengths be less than 50 m. The experimental program included the continued measurement of input impedance, mutual impedance, effective height, and the investigation of terrain effects at remote sites. Results of these tests show that a reasonably flat input impedance can be obtained over the frequency range of 2 to 32 mc, a good impedance transformation to a 75-ohm line can be obtained (less than a 1.15:1 mismatch at 75 ohms) for the same frequency range, the effect of mutual impedance varies from 1,800 ohms when two elements are parallel and one meter apart to greater than 7,500 ohms when the spacing is 5 m, and little is to be gained in antenna sensitivity from element heights greater than 2 m if the ground conductivity is high. Author

N64-27526 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
TYPE OF SERVICE GAINS (RELATIVE SIGNAL-TO-NOISE REQUIREMENTS) FOR RADIO COMMUNICATION SERVICES IN THE HF BAND
Alvaro A. Silva Feb. 1964 19 p refs
(TR-4; AD-440313)

This report provides an estimate of the type of-service gains for typical military communication systems operating in the HF band, and indicates the methods used in obtaining the results. The method of determining the type-of-service gain depends upon the information available for the case under consideration. The method includes use of experimental data, determination from analytical expressions, use of published data and curves, and extrapolation from well-known values by the use of certain assumptions such as power distribution among the channels in a combined multichannel signal. Author

N64-27528 Ohio State U. Research Foundation, Columbus Antenna Lab.
DETERMINATION OF ANTENNA SCATTERING PROPERTIES FROM MODEL MEASUREMENTS
D. L. Moffatt 1 Jan. 1964 43 p refs
(Contract AF 33(616)-8039)
(Rept.-1223-12; AD-441216)

Measurement procedures are described that yield a complete description of the scattering properties of an antenna, either model or full scale. Experimental data are presented on a paraboloidal reflector antenna, horn antenna, and conducting sphere with a radial stub antenna. Author

N64-27603 General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
PRELIMINARY MODIFICATIONS TO CONE-SPHERE THEORY
W. Sawchuk and L. R. Trotta 6 Jul. 1964 22 p refs
(Contracts AF 04(694)-222, AF 04(694)-486)
(Rept.-64SD701; AD-442947)

An attempt to introduce a modified expression for the creeping wave contribution to the radar scattering cross section from a cone sphere was carried out. In addition, a preliminary effort to explain the enhancement of the return from the cone sphere relative to that of the sphere was undertaken. Based on a physical argument, the corrected curves agree extremely well with empirical data when the envelopes of the peaks are compared. However, the oscillations were overdamped in the high KA region. This suggests that the correction for the creeping waves must be lowered while at the same time an enhancement factor must be introduced for the cone sphere join return. Author

N64-27605 ITT Federal Labs., Nutley, N.J.
VLF ENVELOPE TIMING EXPERIMENT Quarterly Progress Reports, 8 Dec. 1963–7 Jun. 1964
R. Aughey Jun. 1964 17 p
(Contract NObsr-89358)
(QPR-3; QPR-4; AD-443459)

This report summarizes the progress made in Phase 1 of the VLF Envelope Timing Experiment. The experiment consists of the fabrication, assembly, test, and delivery of four VLF Envelope Timing Systems. Author

N64-27608 General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
CREEPING WAVE CONTRIBUTION TO SCATTERING FROM LOSSY SPHERES
W. Sawchuk and L. R. Trotta 6 Jul. 1964 16 p refs
(Contracts AF 04(694)-222; AF 04(694)-486)
(Rept.-64SD702; AD-442946)

The graphs in this report give the creeping wave contribution to the monostatic radar scattering cross section from homogeneous spheres as a function of the index of refraction. Seven graphs are enclosed, arranged in order of increasing index of refraction. The present approach provides analytical insight directly on the creeping wave return and determines the minimum values of the refractive index that will isolate the inner metallic core of a material-clad perfectly conducting sphere. The latter is determined by comparing the present solution with the concentric sphere problem, wherein the inner radius is adjusted until the two solutions are approximately equal. The difference in radii, at this point, gives the minimum thickness of the absorbing material necessary to reduce the cross section. These values can then be applied directly to the cone sphere. Author

N64-27611 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
LOGARITHMIC PERIODIC ANTENNA AS-1089(XE-1)/ML
Peter Bodnar Jan. 1963 43 p refs
(USAELRDL-TR-2343; AD-405487)

The electrical and mechanical characteristics of Antenna AS-1089(XE-1)/ML, a small, lightweight, broadband antenna of the broadly directional, pyramidal log-periodic type, are described and discussed. The antenna covers the frequency range of 200 to 800 mc, and has moderate gain and a medium power-handling capability. Data on impedance, gain, pattern characteristics, and power-handling capability have been obtained experimentally and are presented. Although designed specifically for transmitting operations in the frequency range of 275 to 600 mc, the antenna can efficiently transmit over the 200- to 800-mc band, and can receive over the 200- to 1200-mc range. Author

N64-27628 Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
COMPATIBLE TECHNIQUES FOR INTEGRATED CIRCUITS Quarterly Progress Report, 1 Nov. 1963–31 Jan. 1964
[1964] 59 p
(Contract AF 33(616)-8276)
(QR-11; AD-600961)

Effort was concentrated on completing the research vehicles in order to verify technology developed earlier. The

120-mc transreceivers are discussed as to their final design; each individual block is included. The fabrication of research-vehicle devices is covered in terms of special circuits for the digital communication system. The system considerations for the digital communication system research vehicle are included. G.D.B.

N64-27647 New York U., N.Y. Courant Inst. of Mathematical Sciences
BASIC MATHEMATICAL INVESTIGATIONS IN ELECTROMAGNETIC WAVE THEORY Final Report, Apr. 1, 1959–Mar. 31, 1964
[1964] 36 p refs
(Contract AF 19(604)-5238)
(AFCRL-64-384; AD-600952)

The object of the research was to carry out basic mathematical investigations in electromagnetic theory with emphasis on problems of diffraction, waveguides, radiation, and communications. Investigations were conducted in such specific areas as diffraction at high frequencies, diffraction at low frequency radiation, anisotropic surface, far field expansions, and dielectric interfaces. G.D.B.

N64-27656 Harvard U., Cambridge, Mass. Cruft Lab.
RECEPTION AND TRANSMISSION OF TRANSIENT ELECTROMAGNETIC FIELDS
Hans J. Schmitt 13 Jan. 1964 38 p refs
(Contract Nonr-1866(26))
(TR-434; AD-600535)

The receiving and transmitting properties of small linear antennas, conical antennas, and loops for transient electromagnetic fields were investigated experimentally. Short electrical dipoles loaded by a capacitance represented by a cathode follower can be used successfully for the measurement of transient fields with rise times of less than 1 nanosec, if the first antenna resonance is suppressed by a series resistor at the base of the antenna. The currents induced on nonresonant structures by transient electromagnetic fields were investigated, and their application to a direct measurement of the time sequence of the electromagnetic field is discussed. Signals with a simple and known time dependence, such as a unidirectional pulse, can be radiated into space if the reflection of current waves at discontinuities of the antenna structure is avoided. In a manner similar to that useful for the absorption of continuous waves in media with a stratified conductivity, reflections at discontinuities can be avoided by dipoles with tapered resistive loading. Author

N64-27660 Autonetics, Anaheim, Calif. Metrology Lab.
REQUIREMENTS FOR SPECTRAL INTENSITY MEASUREMENTS
Frank K. Koide 5 May 1964 15 p refs Presented at 8th Measurement Res. Seminar, NBS, Boulder Labs., Boulder, Colo.

Existing measurement needs require standards for all measurands on a national exchange basis. Uncertainties contributing to measurement errors are mentioned. Impulse generators are being used to conduct RFI measurement to 15 Gc; measurements in electromagnetic interference (EMI) are in need of standards of increased accuracy. This report briefly discusses present needs, current projects, and future programs to establish superior measurement standards. G.D.B.

N64-27679 Illinois U., Urbana Radiolocation Research Lab.
A PROGRAM FOR PLOTTING RADIOLOCATION PREDICTIONS AND ANALYZING THEIR ERRORS
Roger A. Vossler Mar. 1964 89 p
(Contracts AMC-03720(E); Nonr-1834(02))
(RRL-230; AD-601397)

This program analyzes the errors of radiolocation predictions and evaluates the average range errors, the root mean square range error, and 10-, 20-, and 30- minute cumulative averages of the range errors for both the following: (1) range errors of the predicted range with respect to the true range of the transmitter where range is measured from the receiver; and (2) range errors of the predicted transmitter position where range is measured from the known transmitter location. In addition to this, the computer punches up paper tapes for operating an X-Y plotter. Two types of graphs are obtained in this manner. One is a plot of predicted range error vs time where range is measured from the receiver. The other is a plot of the range and bearing of the predicted transmitter position with respect to the known transmitter location. The latter graph is referred to as a target plot. Author

N64-27683 Emmanuel Coll., Boston, Mass. Research Language Center
THE PROPAGATION OF LONGITUDINAL WAVES IN PLANE DISCS WITH A CIRCULAR HOLE [ZUR AUSBREITUNG VON STOSSWELLEN IN KREISLOCHSCHEIBEN]
Alexander Kromm Bedford, Mass., AF Cambridge Res. Labs., Oct. 1963 26 p refs Transl. into ENGLISH from Z. Angew. Math. Mech. (W. Berlin), v. 28, no. 4, 1948 p 104–114
(Contract AF 19(604)-8505)
(E-T-G-63-30; AD-440905)

The propagation of waves that are caused by a sudden rotary symmetric disturbance at the edge of a circular hole in a disc is investigated. It is assumed that there is a sudden outward, radial force q that is constant in time after its inception. This disturbance is propagated at a velocity $c = \sqrt{E/(1 - \nu^2)\rho}$, i.e., with a wave front such that the jumps in particle velocity and tension decreases as $\sqrt{a/r}$ (a is the radius of the circular hole). The ratio of the velocity jump to the tension jump depends only on the wave resistance $W = \sqrt{E\rho/1 - \nu^2}$, as has been observed in other elastic propagation processes. Behind the wave front, the disc tends to a stationary state. Accordingly, the distribution of the displacements and of the tensions tends to the case of static loading by the force q at the edge of the hole. Author

N64-27684 Lincoln Lab., Mass. Inst. of Tech., Lexington
HAYSTACK ANTENNA SYSTEM STATUS REPORT Technical Report No. 328
A. O. Kuhnel 13 Sep. 1963 72 p refs
(Contract AF 19(628)-500)
(ESD-TDR-63-580; AD-600930)

The Haystack antenna is a component of a high-performance microwave experimental ground terminal to be used for communications, radar, and radio astronomy investigations. The Haystack facility is a Cassegrainian reflector system with a main reflector diameter of 120 ft, a focal length of 48 ft, and a design frequency of 10 kmcps. The antenna is an elevation-azimuth system containing a hydraulic servo system capable of both analog and digital position control. Physical descriptions of the antenna reflector system, elevation-azimuth mount, drive system, angle data system, control system, auxiliary systems, and alignment system are given. The analytical programs in structures and dynamics are briefly described. Author

N64-27688 Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group
PHASED ARRAY STUDY Interim Development Report, 1 Jan.–1 Apr. 1964
28 Apr. 1964 64 p
(Contract NObsr-89427)
(FR-64-14-82; AD-601203)

The transformed switch phase-bit circuit has been improved to yield constant phase across the 10-percent band for all four phase bits. Circuit analysis and design are discussed. The antenna array has been optimally matched for scan angles between ±60 degrees. The power-distribution system for the array has been analyzed for frequency sensitivity. Fabrication of all parts is complete, and parts are now being assembled. Author

N64-27704 Royal Technical U. of Denmark, Copenhagen Ionosphere Lab.
OBSERVATIONS OF WHISTLERS AND VLF-EMISSIONS AT GODHAVN AND NARSSARSSUAQ, GREENLAND, AND AT TROMSO, NORWAY, IN 1962 Technical (Final) Report No. 18
I. M. Jackerott, T. Stockflet Jorgensen, and J. Taagholt Jan. 1964 101 p refs
(Contract AF 61(052)-652)
(AFCRL-64-269; AD-601130) OTS: $2.25

This report presents the whistler and VLF-emission data from Godhavn and Narssarssuaq, Greenland, and from Tromso, Norway, for 1962. Whistlers are found most frequently to occur simultaneously at Godhavn and Narssarssuaq situated 1,000 km apart. The whistlers observed at these sites sometimes correspond to whistlers observed by the ship USS Eltamin at a position in the Antarctic region geomagnetic conjugate to the region south of Greenland. Sometimes the whistlers at Godhavn and Narssarssuaq correspond to whistlers observed at Suffield Experimental Station in Alberta, Canada. Chorus below 2,000 Hz named polar chorus occurs at all three stations at approximately the same geomagnetic time. The polar chorus observed at Godhavn and Narssarssuaq is identical in all details in the structure and most intense at Narssarssuaq, which is situated in the auroral zone. The observations seem to indicate a connection between the auroral zone and the occurrence of polar chorus. Observations of the hiss phenomenon indicate that hiss may be connected with particle streams from the sun, which penetrate the atmosphere of the earth. A correlation was found between hiss, sporadic E, and magnetic disturbances. The hiss occurrence seems to be delayed 1 to 3 days as compared with the magnetic disturbance. Author

N64-27745 Navy Underwater Sound Reference Lab., Orlando, Fla.
IMPEDANCE MEASUREMENT BY GENERALIZED THREE-PROBE METHOD
G. A. Sabin 26 Jun. 1964 11 p refs
(USRL-74; AD-601640)

The three-probe method of impedance measurement, which is based on sampling the standing wave at three discrete positions on a transmission line or waveguide, is analyzed both for the lossless and for the lossy line. General solutions for the load impedance, load admittance, and reflection coefficient are obtained for both cases. The final result is a set of compact formulas in determinant notation. Author

N64-27749 Ohio State U. Research Foundation, Columbus Antenna Lab.
RESEARCH ON TECHNIQUES FOR INTEGRATION OF ACTIVE ELEMENTS INTO ANTENNAS AND ANTENNA STRUCTURE Interim Engineering Report, 1 Dec. 1963–29 Feb. 1964
1 Mar. 1964 15 p ref
(Contract AF 33(657)-10386)
(Rept.-1566-9; AD-600105)

Circuitry for an elementary direction-finding system, using integrated design concepts, is discussed. An array of integrated dipole elements with both electronic phase and gain control is described. A lobe-switching, log-periodic dipole array, which uses a high-frequency diode as the switching element, is discussed. Patterns are presented. Author

N64-27779 Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
RECEIVER SYSTEM NOISE STUDY
William F. Oliver 27 Mar. 1964 55 p refs
(Contract DA-36-039-AMC-03404(E))
(EDL-M658; AD-603627)

Receiver noise-figure and sensitivity calculation (using the noise-temperature approach) is discussed. Two appendixes are included to aid in the consideration of system performance in the presence of a signal, and to present example calculations for a typical VHF-receiver subsystem. Author

N64-27780 Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
SLOT ANTENNA IMPEDANCE FOR PLASMA LAYERS
Janis Galejs Aug. 1963 57 p refs
(RR-346)

The rectangular cavity or waveguide backed slot is covered by a plasma layer of finite thickness. The longitudinal variation of the voltage across the slot is obtained from the variational solution of an integral equation. The solution for a plasma layer of finite thickness is obtained from the free space Green's function by the method of images. The fields outside the slot depend on the surface integral of the fields over the slot plane and over the surface of the plasma layer. If the thickness of the plasma layer is large compared with the wavelength, the fields on the surface of the plasma may be related to the voltage distribution along the slot by plane wave reflection coefficients. This leads to an integral equation that is reduced to a form suitable for machine computations. These calculations show the slot admittance to remain almost constant for plasma layers of various thicknesses h. The slot conductance tends to increase for $h/\lambda < 0.5$. Author

N64-27806* Ohio State U. Research Foundation, Columbus Antenna Lab.
THEORETICAL AND EXPERIMENTAL ANALYSIS OF THE ELECTROMAGNETIC SCATTERING AND RADIATIVE PROPERTIES OF TERRAIN, WITH EMPHASIS ON LUNAR-LIKE SURFACES Semi-Annual Report, 1 Nov. 1962–30 Apr. 1963
1 Jun. 1963 10 p refs
(Grant NsG-213-61)
(NASA-CR-50859; Rept.-1388-10) OTS: $1.10 ph

Theoretical and experimental studies conducted to provide the fundamental data needed to interpret or to design

planetary radar experiments are discussed. Back-scattering measurements from moon-like surfaces were made. Theoretical studies included these: an analysis of the specular part of the lunar scattering in terms of a physical optics model, which predicted a nongaussian second probability distribution and gave an estimate of the rms slope of the intermediate scale features of the lunar surface; fundamental studies in radar photometry, including the solution of the doppler mapping problem in closed form; and studies of the polarization transforming properties of rough surfaces, with application to the interpretation of lunar radar experiments using linear polarization. Preliminary studies were made of a proposed CW lunar radar experiment to be performed with the "Saucer Field" receiving system. R.T.K.

N64-27809* Massachusetts Inst. of Tech., Cambridge Center for Communications Sciences
NOTE ON BINAURAL MASKING LEVEL DIFFERENCES AT HIGH FREQUENCIES
N. I. Durlach [1964] 27 p refs Submitted for Publication
(Grants NsG-496; NSF-G-16526; NIH-G-MB-04737-03)
(NASA-CR-56720) OTS: $2.60 ph

A quantitative black-box model is developed for use in interpreting certain data on binaural masking level differences at high frequencies. The basic idea of this model is that these differences are the result of variations in the extent to which the envelopes of the signals presented to the two ears of the listener are unequal. Author

N64-27833* Space Technology Labs, Redondo Beach, Calif.
STUDY OF MODEL MATCHING TECHNIQUES FOR THE DETERMINATION OF PARAMETERS IN HUMAN PILOT MODELS. REPORT ON TASK 4, TWO-AXIS MODEL
A. F. Meissinger, G. A. Bekey, and R. E. Rose 6 Apr. 1964 38 p refs
(Contract NAS1-2582)
(NASA-CR-56372; Rept.-8426-6005-RU-000) OTS: $3.60 ph

The report presents the approach used in extending model matching to the more complex situation of two-axis tracking where at least eight unknown parameters must be obtained. A separation into sequential computer analysis of each of the two axes of operation is shown to be feasible, and sets of parameters for each axis are obtained. The use of this technique for detecting the existence of cross-coupling terms between the operator's responses and to determine the cross-coupling coefficients quantitatively is of particular interest. This work was conducted with a relatively small amount of analog computing equipment. Author

N64-27852 Illinois U., Urbana Antenna Lab.
SOME THEORETICAL ASPECTS OF LOG PERIODIC AND CONTINUOUSLY SCALED ANTENNA DESIGNS
R. Mittra and K. E. Jones Jun. 1964 43 p refs
(Contract AF 33(657)-10474)
(TR-76; AD-602855)

The transient behavior of log-periodic (LP) and of continuously scaled (CS) structures is discussed. Floquet's theorem for arbitrary periodic structures is generalized for structures containing additional symmetries. On the basis of the generalized version of this theorem, it was found possible to unify the LP and CS structures; to make certain predictions regarding the propagation characteristics (k-β diagrams) of the periodic counterparts of the CS or LP structures; and to separate into a broad class the potential practical and nonpractical antennas for broadband designs. The k-β diagrams of certain periodic structures were applied toward analyzing their tapered version, i.e., LP or CS structures derived from them. R.T.K.

09 ELECTRONICS

Includes circuits and circuit theory; electronic components (e.g., tunnel diodes, transistors, and tubes); and feedback and control theory. *For related information see*: 06 Auxiliary Systems; 08 Communications; 15 Instrumentation and Photography; 22 Navigation and Guidance; and 25 Physics, Solid-State.

N64-27058 Joint Publications Research Service, Washington, D.C.
PHYSICO-TECHNICAL STUDIES IN THE USSR
M. A. Arnitis et al 6 Aug. 1964 41 p refs Transl. into ENGLISH of 3 Articles from Izv. Akad. Nauk Latv. SSR, Ser. Fiz. i Tekhn. Nauk (Riga), no. 1, 1964
(JPRS-25764; TT-64-41035) OTS: $2.00

In these physicotechnical studies, methods of computation and results of the experimental check, using a computing input, of a high-speed bistable stage are discussed; the case of the motion of a body having an internal conical hole conjugate with a vibrating conical surface is examined; and optimum observation in the case of extreme regulation in the presence of high interference is considered. N.E.A.

N64-27079 Stanford Research Inst., Menlo Park, Calif.
A SURVEY AND ASSESSMENT OF PROGRESS IN SWITCHING THEORY AND LOGICAL DESIGN IN THE SOVIET UNION Final Report
William H. Kautz May 1964 34 p refs
(Contract AF 19(628)-2903)
(AFCRL-64-452; AD-443860)

A comprehensive technical survey of Soviet switching theory and its applications to the logical design of digital systems reveals that, despite considerable activity (600 papers and books), its technology in the U.S.S.R. is somewhat behind that in the U.S. However, there are a large number of noteworthy contributions, particularly in those aspects of the field dealing with complexity estimates of switching networks, synthesis of multiterminal circuits, the selection of logical primitives (building blocks), and certain minimization problems. This report evaluates and compares the Soviet position with that in the West, and summarizes the significant technical contributions. Recommendations are offered for monitoring Soviet progress in the future, and for initiating research in the United States in several special problem areas of switching theory. Author

N64-27162 Joint Publications Research Service, Washington, D.C.
CONTRIBUTION TO THE THEORY OF TYPE M TUBE WITH TRANSVERSE INTERACTION
R. A. Dudnik *In its* Izv. VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 198–214 refs (See N64-27151 19-08) OTS: $4.00

A dispersion equation is obtained for a planar model of a type M transverse interaction tube in the small amplitude mode. The roots of the dispersion equation are investigated for the case of sufficiently narrow slow-wave systems with a weak beam current. Author

N64-27163 Joint Publications Research Service, Washington, D.C.
CONTRIBUTION TO THE ANALYSIS OF PROCESSES IN A MULTICAVITY MAGNETRON
V. Ye. Nechayev *In its* Izv. VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 215–235 refs (See N64-27151 19-08) OTS: $4.00

Problems are investigated that are connected with the motion of an individual electron in specified fields of the interelectrode space of a magnetron. Expressions are obtained by the asymptotic method for the velocities and trajectories, up to the second approximation, inclusive. The interaction between a bunched electron beam and the fundamental (synchronous) harmonic of the field is considered, and a formula is derived for the electronic efficiency. Author

N64-27164 Joint Publications Research Service, Washington, D.C.
APPROXIMATE DETERMINATION OF PERIODIC MOTIONS IN A SYSTEM OF AUTOMATIC PHASE CONTROL OF FREQUENCY
R. A. Peskov *In its* Izv. VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 236–243 refs (See N64-27151 19-08) OTS: $4.00

Quantitative characteristics of self-oscillations of the first kind (relative to a zero frequency difference) are determined by the method of harmonic balance for a system of phase control of the frequency considered. The region of values of the parameters of the system in which the method of harmonic balance can be used is determined approximately. Author

N64-27173 Illinois U., Urbana
A NEW CLASS OF TUNABLE RC NULL NETWORKS
D. A. Calahan [1963] 20 p refs
(Grant AF-AFOSR-177-63)
(AD-406998)

The problem of synthesis of a variable-null, grounded lumped element RC network is considered. Necessary and sufficient conditions for realization are discussed, although complete realizability conditions are not derived. An approximation scheme is developed that allows a transmission zero to be varied along the imaginary axis while maintaining a reasonable null characteristic. Measurements on physical models are given. Author

N64-27194 Industrial Science and Technology Agency, (Japan) Electrotechnical Lab.
STUDIES ON TIME OPTIMAL CONTROL AND LINEARIZED COMPENSATION IN RELAY SERVOSYSTEMS
Tadashi Nagata Aug. 1963 93 p refs in JAPANESE; ENGLISH summary *Its* Res. of The Electrotech. Lab. no. 644
(Rept.-644)

Subjects discussed include a relay servomechanism with a pulse-width modulator, a second-order rate feedback-type relay servosystem, using a relay that has hysteresis and deadzone, a practical time-optimal control method, a dual-mode servosystem without any linear power amplifier, and a silicon-controlled-rectifier type of d.c. motor control circuit that is operated by pulse-width modulation. D.E.W.

N64-27195 Westinghouse Electric Corp., Baltimore, Md. Westinghouse Defense and Space Center
STUDY OF MICROCIRCUITRY TECHNIQUES UTILIZING MOLECULAR ENGINEERING Interim Report, 20 Dec. 1963–20 Mar. 1964
[1964] 13 p
(Contract NObsr-81380)
(IR-11; AD-437949)

The objective of this program is the design and construction of pulse amplifiers that are to be packaged at a density of 16 amplifiers per linear inch. The pulse amplifier is an integrated molecular structure consisting of a four-layer switch (PNPN device), input diodes, linear resistor, and a field-effect resistor. This report discusses the amplifier-design considerations as well as the status of fabrication processes, packaging, and test procedures. D.S.G.

N64-27211 Ibrape, S. A. (Brazil) Electronics Application Lab.
TRANSISTORIZED SOUND I.F. AMPLIFIER FOR USE IN A HYBRID T.V. RECEIVER
Oswaldo Kaguiya 30 Apr. 1963 20 p
(BI-029)

The amplifier is for use in a hybrid TV receiver at 4.5 mc and was designed to replace a valve sound IF amplifier. The AM rejection of the amplifier has to be as high as possible, so the transistor is operated as limiter and is overdriven. For this purpose the transistor is polarized to obtain a large voltage amplification. A ratio detector is employed instead of a Foster-Seely detector in order to enhance the AM rejection. The signal of 4.5 mc is taken from the video amplifier output, which has a sufficient voltage signal to enable the IF amplifier to operate with limitation. The voltage supply is 12 v. Author

N64-27239* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
DISCRETE ACTIVITY INDICATOR SYSTEM
George A. Bailey 4 May 1964 30 p refs
(NASA-TM-X-53045) OTS: $2.60 ph

A discrete activity indicator system processes 768 discrete signal inputs and presents information to a computer only when a change in an input occurs. Resolution time of the system is approximately 1.2 milliseconds for 1,000 discrete inputs. A basic clock in the system drives a functional clock, which, in turn, drives a binary counter and six eight-phase drivers in parallel. Each eight-phase driver operates a 128-way current-steering switch, which sequentially interrogates the cores of a 128-bit memory bank. If a change occurs in a discrete signal input (from 0 to 28 v d.c. or 28 to 0 v d.c.), an output is obtained from the associated memory core (when the core is interrogated) and is applied to a sense amplifier. The outputs from the sense amplifier and the binary counter are then applied to a system register for transfer to the computer. These signals allow the computer to determine which discrete signal changed and the direction of the change. When a change occurs, a priority-interrupt circuit stops the interrogation until the computer processes the information. After the information is processed, a clock-start multivibrator allows the interrogation to resume. The power requirement for the system is reduced 75% by using a ground commutator to turn on the discrete drivers of the memory in groups of 16 when each particular group is being interrogated. Positive synchronization between the binary counter and the current-steering switches is provided by a binary synchronizer. Author

N64-27249* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SYNCOM ELECTRONIC PARTS RELIABILITY CONSIDERATIONS
Harry W. L. Street Dec. 1963 89 p ref
(NASA-TM-X-55012; X-600-63-260) OTS: $8.10 ph

This report briefly describes the Syncom I satellite and the manufacturer's parts reliability program, and lists the electronic parts used in its construction. G.D.B.

N64-27270* Motorola, Inc., Scottsdale, Ariz. Military Electronics Div.
JPL STAIRCASE GENERATOR MODULE Final Report, 22 Aug. 1960–29 Sep. 1961
E. Eberhard [1961] 25 p refs
(Contracts NASw-6; NAS7-100)
(NASA-CR-56795; WF-2538) OTS: $2.60 ph

Three staircase generator circuits, (each consisting of an R-C clock, six binary counters, and a summing network) have been fabricated by integrated thin-film methods. Interconnections between submodules are provided by a flexible printed wiring board. The object is to provide circuits having the smallest weight, least volume, and lowest power consumption compatible with high reliability, producibility, accessibility, and cost. A high degree of accessibility is provided. Thin-film submodules may be replaced without damage to themselves or the printed wiring board. Diodes and transistors may be changed on the thin-film R-C submodules. Author

N64-27306* Dynatronics, Inc., Orlando, Fla. Aerospace Systems

ANALOG-TO-DIGITAL CONVERTER FOR HIGH ACCURACY, SEVERE ENVIRONMENT OPERATION Final Report

P. A. Toney, W. R. Brown, III, and J. M. Walter Apr. 1964 49 p (Contract NAS8-5472)

(NASA-CR-56668) OTS: $4.60 ph

The many considerations involving a design approach for a highly accurate (0.05%, exclusive of quantizing error) high-speed analog-to-digital converter exhibiting this accuracy under severe environments (e.g., 105° C temperature range) are discussed. Accuracy, reliability, power consumption, and encoding rate are among these considerations. Types of errors typically encountered in successive-approximation encoding and their antidotes are discussed. An innovation referred to as variable-speed encoding and an analysis revealing its advantage in minimizing overall encoding time while providing maximum accuracy are presented. A detailed description and performance characteristics are given for the analog-to-digital converter (ADC) developed following these design principles. A design discussion of automatic zero and full-scale calibration circuits is included for possible future application, although these circuits were not included in the present ADC because of system considerations. Author

N64-27309* General Electric Co., Syracuse, N.Y. Semiconductor Products Dept.

RESEARCH TO DETERMINE FAILURE MODES FOR TRANSISTORS Quarterly Report No. 2, Jan.–Mar. 1964

Robert C. Quick [1964] 113 p (Contract NAS8-11059)

(NASA-CR-56945) OTS: $9.60 ph

This report is preliminary, giving results of an initial stress response survey made to clarify and adjust procedures for a large scale. Investigation was made of failures by (1) A step stress matrix of temperature, temperature plus voltage, and power for four steps and 100 and 500 hr tread lengths; (2) step stress of centrifuge to 150 kg; (3) vibration–shock and shock–vibration; and (4) noise current measurements at 5 μamp, 100 cycle, 1,000 cycle, and 10,000 cycle; and at 30 μamp, 1,000 cycle. Techniques for screening to noise limits are reviewed, and some indication is given that a noise screen can be used to decrease the percentage failure of some individual types of failure. Author

N64-27320 Joint Publications Research Service, Washington, D.C.

ELECTRONIC COMPUTERS

S. Ya. Berkovich 29 Jul. 1964 50 p refs Transl. into ENGLISH of the book "Elektronnye Vychislitel'nyye Mashiny" Moscow, Inst. of Exact Mech. and Calculating Machines, Acad. of Sci. USSR, 1963 p 3–70

(JPRS-25634; TT-64-31906) OTS: $2.00

For trapped-flux superconductive storage element, there is a regime in which it can store a unit of binary information, providing nondestructive readout. The proposed design of a matrix memory system with linear selection with trapped-flux superconducting elements, possesses along with all the merits of superconducting memory units, the merit of nondestructive readout, simplicity of construction, and reserve of reliability. According to estimates, such memory units, made from presently available elements, could reliably work at frequencies of 10 mc, with drive pulses of 10 nanosec, and amplitudes of 300 ma with permissible spread of 10% to 12%. Matrix schemes with coincident current from trapped-flux superconductive storage elements are difficult to achieve in practice. Author

N64-27321 Joint Publications Research Service, Washington, D.C.

CROWE SUPER CONDUCTIVE MEMORY ELEMENTS

R. A. Chentsov 30 Jul. 1964 87 p refs Transl. into ENGLISH from Elektronnye Vychislitelnyye Mashiny (Moscow), 1963 p 1–87

(JPRS-25648; TT-64-31920) OTS: $3.00

The operation of the Crowe element is analyzed in a matrix with a coincidence of currents, calculating the thermal effects arising during switching. Investigation was made of the limiting cases where electromagnetic relaxation time ($\tau_e = L/R_N$) is much less or much more than the thermal relaxation time ($\tau_t = C/h$), as well as of the intermediate case where $\tau_e = \tau_t$. The analysis is simplified by the assumption of ideally sharp characteristics of the element R(I) and strictly rectangular impulses. Among the basic conclusions of these studies are the following: (1) The behavior of the element may vary greatly, depending on its construction. The operating temperature of the element is also of great importance. (2) The operation of the element in a matrix with a coincidence of controlling currents greatly limits the permissible area of variations of operating parameters. (3) An element with a small τ_t has a higher reliability of operation. Author

N64-27357* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

PUT FETs TO WORK IN ELECTROMETERS

Robert Munoz Repr. from Electron. Design, 11 May 1964 5 p refs

(NASA-RP-281)

Field-effect transistors (FET), with their high impedance and low noise, can effectively measure very low currents. A feedback scheme for an operational amplifier is presented with an FET as the input stage. The electrometer amplifier based on this scheme demonstrated that, using commercially available FETs, it is possible to measure currents as low as 10^{-13} amp over 1 cps bandwidths. D.S.G.

N64-27376 Lincoln Lab., Mass. Inst. of Tech., Lexington

THE VARIABLE-DRIFT KLYSTRON—A HIGH-EFFICIENCY AMPLIFIER

I. Hefni and M. A. Nader 8 Apr. 1964 21 p refs (Contract AF 19(628)-500; ARPA Order 85)

(ESD-TDR-64-44; Tech. Rept.-350; AD-441439)

The variable-drift biased-gap klystron is a new type of multicavity klystron in which part of the d.c. potential is distributed along the RF interaction region. Experimental values of increased efficiencies have been determined, and they are in reasonable agreement with the theory. It is concluded that the main advantages of this klystron are high efficiency (70 percent), improvement in beam transmission, and high-gain stability. Author

N64-27406 Aeronautical Research Labs., Melbourne (Australia)
SINE AND COSINE FUNCTION GENERATORS FOR AN ANALOGUE COMPUTER
K. F. Fraser Jul. 1963 25 p refs
(ARL/I-63)

The design of sine and cosine function generators for use in the A.R.L. Analogue Computer is detailed. The generators incorporate diode switching circuits to obtain a piecewise linear approximation to the required functions. Author

N64-27413 Electromagnetic Technology Corp., Palo Alto, Calif.
FREQUENCY CONVERTER UNITS FOR L-BAND, S-BAND, C-BAND, AND X-BAND Interim Development Report, 1–31 May 1964
William A. Edson 15 Jul. 1964 14 p
(Contract NObsr-89536)
(Rept.-11; AD-441244)

Investigations of a sample D5253 diode were started. The conversion loss is good and the impedances are acceptable. A series of life tests on 1N53-type mixer diodes has shown some degradation can be expected to occur between 5 and 10 mw. Work was started on a double-balanced converter suitable for use with the D5253 diode. An improved single-crystal holder to be used to obtain detailed information on the D5253 diode was designed and is being built. Author

N64-27424 Hughes Aircraft Co., Fullerton, Calif. Radiation Effects Research Dept.
ANALOG TRANSIENT RADIATION RESPONSE ANALYSIS FOR MULTIPLE-CIRCUIT SYSTEMS Final Report, Jan. 1963–Jan. 1964
K. R. Walker et al Kirtland AFB, N. Mex., AF Weapons Lab., Jun. 1964 390 p refs
(Contract AF 29(601)-5816)
(WL-TDR-64-41; AD-603337) OTS: $7.70

Simplified transfer function techniques and curve-follower representations have been developed for predicting the responses of multiple-circuit systems in a transient gamma radiation environment. These analysis methods are applicable to normally linear circuits that may be driven nonlinear (cutoff or saturation) by radiation and to nonlinear switching circuits. The radiation responses of a linear five-stage amplifier and a four-stage switching circuit were determined. The radiation responses of these circuits were also obtained from a complete analog computer analysis of each circuit. The radiation responses obtained from the simplified methods were identical to the complete analysis results. Author

N64-27442 Radio Corp. of America, Bethesda, Md. Data Systems Center
FACT CORRELATION EXPERIMENTATION
N. H. Hardwick, S. N. Jacobson, D. E. Rogers, and G. H. Woolley Griffiss AFB, N.Y., RADC, May 1964 171 p refs
(Contract AF 30(602)-2979)
(RADC-TDR-64-190; AD-603697)

The effort described in this report covers several facets of an experimental program to develop and test techniques leading to the realization of a fact-correlation capability. Primarily, these techniques are linguistically oriented and particularly are concerned with paragraph analysis, the ability to reorganize natural language text in a meaningful way using automatic and semiautomatic methods. Nonlinguistic approaches based on vocabulary manipulation were also investigated to a limited extent. The rationale, development, and implementation of techniques are described in some detail. The test vehicle for evaluating these techniques measures their performance in reassembling previously segmented documents. To provide data for the specification of the techniques a sample of scientific documents was prepared for machine processing. A similar sample containing documents matching those in the analysis sample is available for testing the ability of the techniques to reassemble documents. Computer programs representing a document reassembly system to test the linguistic techniques were written in the COMIT programing language for the IBM-7090 computer. Programs for document reassembly to test other techniques were implemented on the RCA-301 computer. Author

N64-27455 Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group
QUANTIFICATION OF ELECTRONIC CIRCUIT CONNECTION TECHNIQUES Final Report, Jul.–Dec. 1963
R. E. Schafer and W. Yurkowsky Griffiss AFB, N.Y., RADC, May 1964 96 p refs
(Contract AF 30(602)-3177)
(RADC-TDR-64-46; AD-603250)

This study is directed toward gathering reliability data on several presently used electronic circuit connection types. Laboratory and field reliability reports were gathered from known producers and users of electronic equipment. A restriction was placed on the study that no data from controlled tests were generated during the study period. In all, data for 350 billions of connection operating hours were collected during the 6-month study. The data covered 6 types of connections—solder, resistance welding, wire wrap, crimp, ultrasonic welding, and thermal compression bonding. The number of operating hours was small, and no failures were noted in the reports obtained on the latter two types of connections. The remainder of the study, therefore, was concentrated on the four connection types on which sufficient data were available. Failure rates and confidence intervals were claculated and compared for each of the four connection types. These were based on the general types of equipments from which the reliability reports were collected. Additional calculations were based on the laboratory reliability test reports. Mathematical analyses were performed on the data collected in an attempt to measure the effects of environmental stresses on connection failure rates. A merit index was developed so that designers may select optimum types of connections for use in various applications. The details of factor and subfactor selection and their quantification are described. Application weights for several classes of Air Force Ground equipments are developed and presented. Author

N64-27456 Syracuse U., New York
ON THE PROBABILISTIC CIRCUIT THEORY
F. M. Reza Griffiss AFB, N.Y., RADC, May 1964 85 p refs
(Contract AF 30(602)-3252)
(RADC-TDR-64-180; AD-603249)

A probabilistic circuit is an electric circuit where the element values in the circuit are controlled by probability. This report deals with four topics dealing with such systems. Calculations are derived for the first two moments of a rational linear system function. Applications are made of the Cramer–Linnik–Raikov decomposition theorems to continuous communication system channels. The use of set theory diagrams in the evaluation of entropy relations in discrete random variables is discussed. Detailed calculations are made for the probabilistic description of the system function of a series RLC circuit having normal component distribution. Author

N64-27475 Pickard and Burns Electronics, Waltham, Mass.
ATOMIC OSCILLATOR DEVICE FOR NAVIGATION—GUIDANCE Interim Engineering Report No. 3

R. H. Woodward, L. Johnson, R. Sanborn, I. Felch, and R. L. Smith Wright-Patterson AFB, Ohio, ASD, 30 Jun. 1964 89 p
(Contract AF 33(657)-11384)
(P&B-894; ASD-TDR-64-3; AD-603245) OTS: $4.00

Design features of the first prototype cesium beam tubes were finalized. The design includes a hexapole optics system, an annular ionizer, coaxial microwave cavity, and solenoidal C-field. Breadboard primary loops were constructed using BLR-2 beam tubes. Stable closed loop with gain of 20×10^6 was tested. Spectral purity and quadrature effect were investigated. Both must be improved before tests of stability and reproducibility are started. Author

N64-27496 Royal Inst. of Tech., Stockholm (Sweden)
BASIC STUDIES ON AMPLIFICATION AND GENERATION OF SIGNALS IN ELECTRONICAL CIRCUIT
Per-Olov Leine 27 Apr. 1964 26 p refs
(Grant AF-EOAR-61-43)
(AFCRL-64-514; AD-602985)

A theoretical discussion of gain and the stability of gain in linear networks is presented, as considered from the standpoint of power only. Included in the discussion are these: (1) the simple case of transistor feedback; (2) canonical form for active devices with thermal storage; and (3) available logarithmic gain when the gain-function is prescribed, except for a constant, and when available Dirac pulses of gain do exist. P.V.E.

N64-27540 Hughes Aircraft Co., Oceanside, Calif. Vacuum Tube Products Div.
RESEARCH AND DEVELOPMENT OF TWO-COLOR DIRECT VIEW STORAGE TUBE WITH SELECTIVE ERASURE Interim Development Report, 1 Jan.–1 Apr. 1964
P. P. Damon Apr. 1964 16 p refs
(Contract NObsr-89452)
(AD-600385)

A direct view storage tube is being developed that is capable of displaying stored information in either of two colors or in intermediate hues, and selectively erasing that information. The operating principle is based on the fact that flood electrons that pass through holes in the storage mask when the storage-surface potential is near cutoff fall within small areas on the viewing screen opposite the storage mask holes; whereas flood electrons that pass through the holes when the potential is near its maximum, (i.e., flood gun cathode potential) fall on larger overlapping areas of the viewing screen. The viewing screen consists of two phosphors. One occupies small areas in register with the storage-mask holes, while the other occupies areas surrounding the first. This tube is 10 in. in diameter. It differs from the tube developed under another contract in that a selective erase feature was added and an axial flood gun was utilized. The additional selective erase gun permits viewing of the stored information at the written chromaticity until just prior to introduction of new information. Color tubes were constructed with 150-line storage mesh. Data on these tubes show the green phospor efficiency was good, but the red phosphor efficiency was exceptionally low. Target performance was normal and registration excellent, although the uniformity of color shift was affected by a moiré effect; a higher-count collector mesh was used to reduce this effect. Author

N64-27572 Illinois U., Urbana Coordinated Science Lab.
A MODULAR REALIZATION OF SYMMETRIC SEQUENTIAL MACHINES
Don W. Rain Nov. 1963 38 p refs
(Contract DA-36-039-AMC-02208(E))
(R-183; AD-433821)

The purpose of this thesis is to investigate the realization of a class of sequential machines that display certain symmetries in their state diagrams. The thesis is concerned with the cascade-parallel interconnection of elementary, rather than arbitrarily complex, asynchronous sequential machines. It is recognized that not all sequential machines may be realized using these elementary modules, nor will the machines developed be necessarily minimal. Additional feedback around a (Huffman model) machine may be used to eliminate certain states of the state diagram. This feedback is restricted only in that the delay through the feedback path must be greater than the delay associated with the secondary variables around which the feedback is made. Interconnections of elementary modules yield machines have symmetric state diagrams, and feedback may be used to create certain asymmetries. Some techniques that are useful for establishing rules that allow a given state diagram to be embedded in a symmetric or almost symmetric state diagram are also presented. Author

N64-27573 Illinois U., Urbana Coordinated Science Lab.
SPEED INDEPENDENT NOR REALIZATIONS
Kenneth E. Batcher May 1964 47 p refs
(Contract DA-28-043-AMC-00073(E))
(R-205; AD-439439)

The main result of this study is that there exists a speed-independent NOR realization for a given flow table if the table has no essential NOR hazards. In particular, tables where only one input variable changes state at a time are realizable. Also, tables where when more than one input variable changes state, all changing variables change from 0 to 1 are realizable. Other tables may or may not have essential NOR hazards, depending on the action specified for input transitions where more than one line changes state and at least one line is switching from 1 to 0. Author

N64-27625 Michigan U., Ann Arbor Electron Physics Lab.
BASIC RESEARCH IN MICROWAVE DEVICES AND QUANTUM ELECTRONICS Quarterly Progress Report No. 4, Feb. 1–May 1, 1964
H. K. Detweiler, M. E. El-Shandwily, B. Ho, J. E. Rowe, and C. Yeh May 1964 35 p
(Contract NObsr-89274)
(Rept.-05772-4-P; AD-601434)

In the generation and amplification of coherent electromagnetic energy in the millimeter and submillimeter wavelength region, the construction of the experimental low-frequency multiplier with feedback scheme to enhance the transfer efficiency has been completed. The d.c. beam testing shows that the tube is aligned satisfactorily. A nonlinear theory of the amplitude and phase-modulated traveling-wave amplifier with a multiple frequency input is developed. Computer results for some typical cases are presented and interpreted. In the study of a d.c. pumped quadrupole amplifier, the mechanism of an anomalous gain predicated for the cyclotron-to-synchronous wave interaction is explained in terms of kinetic power relations. Experimental results from other sources give support to this theory. Author

N64-27626 National Co., Inc., Malden, Mass.
CESIUM BEAM TUBE STUDIES Quarterly Progress Report, 1 Oct. 1963–1 Jan. 1964
J. George and E. Wunderer [1964] 31 p refs
(Contract DA-36-039-AMC-02367(E))
(QPR-2; AD-601617)

The experiment design for the measurement of cesium beam effusion patterns was completed, and experimental measurements were performed. Beam intensity was measured as a

function of beam angle and source temperature. It was determined by analysis that the molybdenum waveguide is superior to the 403 Monel waveguide for use in the proposed microwave structure. Preliminary magnetic shielding measurements were made on Mumetal shields. Author

N64-27627 Mictron Inc., Albany, N.Y.
C.W. X-BAND VOLTAGE TUNABLE MAGNETRON Quarterly Progress Report, 1 Jan.–31 Mar. 1964
M. R. Boyd and M. Weinstein [1964] 16 p
(Contract DA-36-039 AMC-03270(E))
(Rept.-3; AD-601594)

Research activity was concentrated in the construction and RF testing of two tubes over a wide frequency range. Circuit work was initiated and was used in conjunction with the two designs investigated. R.T.K.

N64-27652 General Electric Co., Owensboro, Ky. Tube Dept.
BASIC RADIATION EFFECTS MECHANISMS STUDY ON ELECTRON TUBES Quarterly Progress Report, 1 Dec. 1963–29 Feb. 1964
E. E. Calme, B. I. Grady, R. J. Maier, and W. J. Patterson [1964] 68 p refs
(Contract DA-36-039-SC-90735)
(QTR-7; AD-441673)

Two test devices were exposed to the Sandia Pulsed Reactor environment in an effort to detect the desorption of gas from electron tube materials as the result of the incident nuclear radiation. One device was used to determine the effect on the glass envelope of the tube, and the other device was used to determine the effect on a complete tube assembly. A detailed analysis of the results of this experiment is presented. Equations are developed for determining the energy spectrum of secondary electrons emerging from a piece of irradiated material. A preliminary description of equations to be used in the data analysis work is included. The effect of high temperature on the transient response of ceramic insulators was studied. A comparision of transient effects on a metal with typical electron tube surface contamination was made with effects on the same metal having a relatively clean surface. Author

N64-27696 Clevite Corp., Cleveland, Ohio Electronic Research Div.
RESEARCH INTO NEW APPROACHES FOR VHF FILTER CRYSTALS Quarterly Report, 1 Nov. 1963–31 Jan. 1964
D. R. Curran and D. J. Koneval 19 Mar. 1964 46 p refs
(Contract DA-36-039-AMC-2245(E))
(QR-3; AD-600118)

Experiments with rectangular electrodes on 10-mc AT-cut quartz wafers have verified the dependence, predicted by energy-trapping theory, of fundamental and inharmonic overtone mode frequencies on resonator design parameters. From these, a generalization of the Bechmann criterion on maximum electrode dimensions has been proposed to include crystallographic orientation and the effect of electrode mass loading. Feasibility for multielectrode filter crystals has been demonstrated with the fabrication of two samples with 4 dot resonators per wafer. Each set of dot resonators was electrically connected in parallel to form the equivalent of an oversized single resonator, with resultant motional characteristics adding in the predicted fashion. Author

N64-27706 Radio Corp. of America, Harrison, N.J. Electron Tube Div.
AN L-BAND TUNNEL DIODE OSCILLATOR Quarterly Progress Report, 1 Dec. 1963–29 Feb. 1964
D. E. Nelson, R. Gold, and E. T. Casterline [1964] 18 p
(Contract DA-36-039-SC-90773)
(QPR-7; AD-601061)

A standard process for fabricating 600-ma gallium arsenide tunnel diodes was evolved. A simplified RF circuit, which simplifies packaging in a small volume, was developed. A new transistor current regulator for TDOs was given preliminary test. A transistor modulator for FM modulating the TDO was fabricated. The unit meets the required pulse width and repetition frequency for the specified values of control resistance. Author

N64-27707 General Electric Co., Owensboro, Ky. Tube Dept.
LOW-POWER, X-BAND, PLATE-PULSED OSCILLATOR Fourth Quarterly Report, 1 Nov. 1963–31 Jan. 1964
J. M. Connelly and J. R. Peterson [1964] 38 p refs
(Contract DA-36-039-AMC-00132(E))
(Rept.-4; AD-601476) OTS: $1.00

Sixty-six experimental tubes representing four type constructions were assembled and evaluated. Few of the tubes tested at X-band delivered more than 50 w at rated heater voltage. The low yield resulted primarily from inadequate pulse cathode emission from the oxide-coated cathode. Grid contamination that was responsible for rapid cathode emission slump was discovered in one group of tubes. The contamination was caused by pickup of impurities during a copper-plating operation. A 26-mc frequency shift was measured on an uncompensated oscillator when the ambient temperature was changed from −30° to 100° C. An improvement in life performance resulted when the cathode temperature of the tube was reduced and the modulating pulse voltage was increaded. Two tubes are operating well at the 500-hr life point with e_b = 2000v. Author

N64-27709 Zenith Radio Corp., Chicago, Ill. Research Dept.
DEVELOPMENT OF A HIGH FREQUENCY ELECTRON-BEAM PARAMETRIC AMPLIFIER Quarterly Progress Report, 1 Apr.–30 Jun. 1963
Peter G. Everett [1963] 24 p refs
(Contract DA-36-039-SC-88915)
(QPR-8; AD-422928)

To reduce possible effects due to the beam diameter being a large fraction of a cyclotron wavelength, a Pierce gun was designed to produce an 0.010-in.-diam beam. An accident occurred resulting in damage to the gun that was repaired; however, beam temperature measurements are not yet available. An experiment that attempted to vary the cathode emission area by applying negative potentials to the Pierce electrode did not give a positive result. Further measurements are reported on the 400-mc tube, with 1,000-mc cyclotron frequency. The sources of excess noise in this tube are discussed. Author

N64-27711 Edgerton, Germeshausen and Grier, Inc., Boston, Mass.
DEVELOPMENT OF A SUPER POWER DEUTERIUM THYRATRON Fourth Quarterly Report, 14 Mar.–13 Jun. 1964
Nicholas Reinhardt 19 Jun. 1964 10 p
(Contract NObsr-89405)
(B-2839; AD-601644) OTS: $0.50

Five prototype tubes were evaluated, and an extensive investigation of the fabrication and processing procedures was conducted. All five tubes were new starts that were built during the reporting period. The separate tube fabrications and processings were undertaken as a step-by-step attack on the problems of temperature, metallic deposits, and gassiness observed

in previous starts and in the investigation of mockup structures. Details of the investigations and of the individual tube starts are given. The conclusions and recommendations are presented. Author

N64-27712 Calvin Coll., Grand Rapids, Mich.
SILVER MIGRATION AND TRANSPORT MECHANISM STUDIES IN SILVER OXIDE-ZINC BATTERIES Quarterly Technical Progress Report, 1 Mar.–1 Jun. 1964
T. P. Dirkse [1964] 19 p refs
(Contract AF 33(615)-1236)
(QTPR-2; AD-601471)

The effect of the presence of surfactants in the electrolyte of silver–zinc batteries on the cycle life has been briefly investigated. In some cases, there is an improvement in cycle life. To determine the reason for this, the effect of surfactants on the following processes has also been investigated: (1) silver ion diffusion through cellophane; (2) throwing power of a potassium zincate solution; (3) limiting passivation current density for the zinc anode; (4) polarographic reduction potential of zincate ions; and (5) zincate ion diffusion through cellophane membranes. Author

N64-27725 Union Carbide Corp., Cleveland, Ohio Linde Div.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID TANTALUM ELECTROLYTIC CAPACITORS First Quarterly Progress Report, 1 Jul.–30 Sep. 1963
J. E. Riley 1963 31 p refs
(Contract DA-36-039-AMC-03624(E))
(AD-425246)

Discussed is the concept of the accelerated life testing of tantalum capacitors, based upon the Weibull statistical distribution. Techniques for the practical application of this theory to accelerated life testing, and a comprehensive test matrix for the determination of acceleration factors are presented. Other major activities include tantalum powder evaluation, anodic formation of tantalum pentoxide (Ta_2O_5), manganese oxide impregnation, and anodic reformation. Author

N64-27727 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURES TO INCREASE TRANSISTOR RELIABILITY. PROCESS SPECIFICATIONS Final Engineering Report
Jul. 1964 147 p
(Contract DA-36-039-SC-86730)
(Rept.-03-64-46; AD-602941)

Diffusing silicon planar, developing metal etch resist, cleaning silicon diffused planar boat, activating hydrofluoric acid before first nickel, and inspecting bonded devices are some of the process specifications presented to increase transistor reliability. G.D.B.

N64-27728 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURES TO INCREASE TRANSISTOR RELIABILITY. PROCESS SPECIFICATIONS Final Engineering Report
Jul. 1964 77 p
(Contract DA-36-039-SC-86730)
(Rept.-03-64-42; AD-602942)

These are process specifications to increase transistor reliability, which include material on etching bars, inversion layer detection, alloying bars to ceramic, testing for bubble leaks, temperature cycling, final inspection, and other processes of interest to transistor manufacturers. G.D.B.

N64-27729 Silicon Transistor Corp., Carle Place, N.Y.
PRODUCTION ENGINEERING MEASURE TO INCREASE THE RELIABILITY OF THE TRANSISTOR TYPE 2N2034 Quarterly Progress Report, 1 Jan.–31 Mar. 1964
J. Cocking, J. Courier, F. Des Roches, D. Hughes, and E. Martin [1964] 50 p
(Contract DA-36-039-AMC-01482(E))
(QPR-3; AD-603256)

Seven tasks are discussed to increase transistor reliability—wafer cleaning, mesa delineation, scribing, soldering, final etch, final test and encapsulation, and hermetic seal. G.D.B.

N64-27733 Motorola, Inc., Scottsdale, Ariz. Military Electronics Div.
MINIATURE THIN FILM INDUCTORS (MODIFICATION NO. 2 Final Development Report 27, May 1963–27 May 1964
F. R. Gleason 30 Jun. 1964 63 p
(Contract NObsr-85397)
(WF4003; AD-602270)

The technique for depositing the ferrite film by the spray hydrolysis of a chloride solution is described. Films possessing the characteristic ferrite spinel structure and a reproducible nickel, zinc, cobalt ferrite composition were deposited at 600° to 800° C. The permeability of the film increased with increased temperature. A postdeposition firing of the film further increased this permeability. This firing temperature was restricted to 1025° C by the gold spiral coil. The spiral coils were made from gold and deposited by a combination of vacuum evaporation and electrodeposition techniques. The maximum air core coil inductance obtained in an area 0.3 $in.^2$ was 1.8μh. The largest inductance value obtained for a single encapsulated coil was 54μh with a Q-value of 6 at 1 mc. The inductance obtained was limited by the thickness of the ferrite film deposit (a flux saturation effect) and by the relatively low temperature at which the sample was fired after film deposition. The reasons for these limitations and various unsuccessful methods tried to overcome them are described and discussed. Author

N64-27738 Radio Corp. of America, Harrison, N.J. Microwave Tube Operation Dept.
A 10-Nw, X-BAND TUNNEL-DIODE OSCILLATOR Third Quarterly Progress Report, 1 Jan.–31 Mar. 1964
E. Diamond, E. Casterline, R. Gold, and D. Nelson 23 Nov. 1962 31 p
(Contract DA-36-039-AMC-03195(E))
(QPR-3; AD-602720)

Tunnel diodes with peak currents of 35 to 75 ma were tested in coaxial circuits, with load impedances varied from 1 to 8 ohms. The best results to date were obtained with a 50-ma diode and a load impedance of 1 ohm. This diode gave 2.0 mw at 7.9 gc, which is close to the theoretically calculated power output of 2.5 mw at 8.5 gc. It is expected that minor changes in the circuit will yield between 2.0 and 2.5 mw of RF power at the design frequency of 8.5 gc. Author

N64-27746 HP Associates, Palo Alto, Calif.
SEMICONDUCTOR MATERIALS Interim Engineering Report, 27 Dec. 1963–26 Mar. 1964
R. J. Archer, O. R. Cook, T. L. Larsen, E. E. Loebner, H. Luechinger et al [1964] 28 p refs
(Contract NObsr-89489)
(IER-3; AD-601059)

The continuing work on integrated GaAs and GaAs-P el diode arrays is described. Experiments are reported on heat-treatment attempts to improve the quality and uniformity of GaAs-P raw materials. External el quantum yield of state-of-the-art GaAs-P crystals is compared with those of GaAs materials. A preliminary discussion of control, storage, and switching matrices for injection el display panels is given. Author

N64-27771 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
SPARK-GAP STUDIES
S. Levy Apr. 1964 24 p refs
(USAELRDL-TR-2454; AD-601085)

Erosion measurements were made using copper–tungsten as an electrode material. The erosion rates for this material were far below the erosion rates for other electrode materials shown in the literature. Tests were performed with and without a saturable reactor in the anode circuit. With the saturable reactor, a reduced electrode erosion was observed. Various triggering schemes were evaluated. Ultraviolet light decreased the time jitter from 0.4 μsec to below 5 nanosec. The same result was achieved by compressed-air cooling of the electrodes. Author

N64-27836* Tennessee U., Knoxville
A GENERAL THEORY ON MULTIVARIABLE ERROR-FREE RIPPLE-FREE SAMPLED-DATA CONTROL SYSTEMS
A. M. Revington and J. C. Hung 1 Aug. 1963 62 p refs
(Grant NsG-351)
(NASA-CR-56780; SR-3) OTS: $6.60 ph

This report considers a multivariable system, described by the P-canonical structure, utilizing two digital controllers, one in the forward loop and one in the feedback loop. The controllers are designed to obtain the fastest error-free and ripple-free input–output responses, and the fastest neutralization of disturbances. Two matrices are fundamental to the design, the matrix K, relating the output response and the input response, and the matrix L, relating the output due to a disturbance in the system forward loop to the disturbance itself. The performance criteria, the fundamental requirements for interacting or noninteracting systems, and the conditions for independent output restoration are implemented directly into these two matrices. The matrices are restricted by the nature of the inputs, the disturbances, and by the plant itself. Author

N64-27857 Illinois U., Urbana Coordinated Science Lab.
THE SCATTERING MATRIX: NORMALIZED TO COMPLEX N-PORT LOAD NETWORKS
R. A. Rohrer May 1964 34 p refs
(Contract DA-28-043-AMC-00073(E))
(R-206; AD-601157)

The scattering matrix is normalized to complex n-port loads, and some of the elementary properties of this generalized scattering matrix are discussed. The normalized scattering matrix is obtained in a straightforward manner from both the current-basis and voltage-basis scattering matrices. These matrices are presented from the measures of the deviation of actual circuit behavior from optimal circuit behavior. The optimal matching condition employed is the specialization to the time-invariant case of that obtained for complex, time-varying n-port networks excited by arbitrary waveforms. Author

10 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands and wind tunnels); test ranges; and tracking stations. *For related information see* 06 Auxiliary Systems.

N64-27262* Technical Operations Research, Washington, D.C. Washington Research Center
COMMUNICATIONS SATELLITE SYSTEMS: A COMPUTER MODEL AND RELATED ANALYSIS. VOLUME II: THE MODEL AND ITS USE
J. A. Bancroft, D. E. Muir, M. M. Spierer, E. H. Kingsley, T. W. Schwenke et al Washington, NASA, 12 Sep. 1964 44 p refs
(Contract NASw-546)
(NASA-CR-55888; TOR-W63-1)

The Technical Operations communications satellite model, programed for the IBM-7090/7094, consists of six major routines and one associated subroutine. The major routines are the Launch, Orbit, Coverage, Assignment, Queue, and Cost. The subroutine is the Demand routine. Also discussed is a Ground Location Model, the purpose of which is to define a minimum-cost ground network. R.T.K.

N64-27349 Kyoto U. (Japan)
PERFORATED PLATE TECHNIQUE IN HYPERSONIC GUN TUNNEL
Goro Kamimoto, Toshikazu Mori, and Takeyoshi Kimura Apr. 1964 21 p refs
(CP-6)

A modified technique improves the operation of a gun tunnel. If the cross sectional area of orifice of a perforated plate inserted at the first diaphragm section is suitably chosen, the fluctuation of piston motion associated with the expansion wave can be eliminated near the barrel end, i.e., the piston is brought to rest without fluctuation and the running time of the tunnel increases. Measurements of the pressure histories in the barrel and of the piston motion by a microwave technique were carried out, and the best size of perforated plate was determined experimentally. Author

N64-27371 Kyoto U. (Japan)
AN ANALYSIS OF THE PISTON MOTION IN A HYPERSONIC GUN TUNNEL
G. Kamimoto, T. Mori, and T. Kimura Jan. 1964 26 p refs
(CP-5)

A theoretical analysis and some experimental results of the piston motion in the hypersonic gun tunnel are described. The piston motion has close effects upon the uniformity of flow at the test chamber; i.e., the fluctuation of the piston near the barrel end disturbs the pressure and makes the running time decrease. To prevent such a motion and to obtain good performance of the tunnel, the perforated plate technique has been applied. The calculation of the track of the piston is developed into the case with the perforated plate. On the other hand, the actual piston motion is measured by the microwave technique, and it is proved that the test results agree well with the analytical results. Author

N64-27391* Florida State U., Tallahassee Inst. of Governmental Research
URBAN GROWTH IN THE NATION'S SPACEPORT
Harry A. Green [1964] 14 p refs Submitted for Publication
(Grant NsG-508)
(NASA-CR-56204) OTS: $1.60

This is a study of urban growth as it relates to the Florida counties adjacent to Cape Kennedy. The pattern of government in this region is examined. The problems created by this rapid growth are discussed; water and sanitation are a major factor. Urban planning and transportation and traffic engineering are suggested. G.D.B.

N64-27411 Midwest Research Inst., Kansas City, Mo.
THE STRUCTURE AND STRENGTH OF EPITAXIAL FILMS Bimonthly Progress Report, 17 Feb.–17 Apr. 1964
Melvin Lavik 15 May 1964 12 p
(Contract NOw-64-0061-d)
(BPR-3; AD-600149)

Most of the experimental equipment, designed for deposition and evaluation of epitaxial films on single crystal substrates, has been assembled. Discussions and photographs of the evaporation oven, substrate holder, vacuum system, and stress mechanism are presented. Brief reviews are given on the design of a strain measuring system. Author

N64-27421 Hughes Aircraft Co., Fullerton, Calif. Communications Div.
SATELLITE COMMUNICATIONS TERMINAL AN/MSC 46 ( ) (MARK 1B) First Quarterly Progress Report, 15 Jan.–15 Apr. 1964
D. E. Ross [1964] 113 p refs
(Contract DA-36-039-AMC-03744(S))
(FR-64-19-87; CDP-1528; AD-441802)

Program planning, specifications review, and, in some areas, preliminary design have been completed in the Mark 1B program to design, fabricate, and test a microwave air- and ground-transportable satellite-communication-link terminal. A description, functional operation, and design status of the system components are given. D.S.G.

N64-27781 Federal Aviation Agency, New York, N.Y. Airports Div.
A STUDY OF THREE AREAS FOR A JETPORT TO SERVE METROPOLITAN NEW YORK A Review of Environmental Factors
31 May 1963 24 p ref

Environmental factors are considered in evaluating three general areas of Burlington County, New Jersey, Orange County, New York, and Suffolk County, New York as possible choices for an airport site. Climate, topography, land use, and accessibility are discussed for each of these regions. No attempt is made to select any one of them over the other as the site for an airport or to make any but the most general recommendations. A.W.

11 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; 13 Heat Transfer and Thermodynamics; and 24 Physics, Plasma.

N64-27053 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
EXPERIMENTAL INVESTIGATION OF PRESSURE DROP AND FLOW VELOCITY DISTRIBUTION IN PIPES WITH REGULAR PATTERN OF ROUGHNESS IN TURBULENT FLOW
Heinz Mobius 13 Jul. 1964 46 p refs Transl. into ENGLISH from Physik. Z. (Leipzig), 41, 1940 p 202–225
(RSIC-220; AD-443428)

Determinations of pressure drop and flow distribution in pipes having regular and varying patterns of roughness are shown in graphic and tabular forms. Ten pipes were used for the measurements of pressure-drop coefficients; the pipes had varying roughnesses and varying orifices. Three rough pipes and a smooth pipe were used to determine the velocity distribution. Comparisons are made of Reynolds numbers for smooth and rough pipes, and of pressure-drop coefficients and the velocity distribution with Prandtl's theoretical expressions for fluid viscosity. A.L.B.

N64-27124* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
HYDROSTATIC STABILITY OF THE LIQUID-VAPOR INTERFACE IN A LOW-ACCELERATION FIELD
William J. Masica, Joseph D. Derdul, and Donald A. Petrash Washington, NASA, Aug. 1964 13 p refs
(NASA-TN-D-2444) OTS: $0.50

As a part of the overall study of the behavior of rocket engine propellants stored in space vehicle tanks while exposed to weightlessness, a study was conducted to determine the hydrostatic stability characteristics of the liquid–vapor interface in a cylindrical container when subjected to low acceleration disturbances (less than 1 g) applied parallel to the longitudinal axis of the cylinder. The Bond number criterion, a dimensionless parameter consisting essentially of the ratio of acceleration to capillary forces, was found to be valid for predicting the regions of hydrostatic stability of the liquid–vapor interface. The critical Bond number delineating the stable and unstable regions was independent of the applied acceleration field and was verified to be 0.84 for solid–liquid–vapor systems possessing 0° contact angles. Author

N64-27127 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
DETERMINATION OF SPEEDS IN AXIAL TURBOMACHINE, TAKING INTO ACCOUNT DISTORTION OF CURRENT LINES IN MERIDIONAL PLANE
A. N. Sherstyuk and V. P. Novoderezhkin *In its* Heat Power Eng. 8 Mar. 1963 p 1–10 refs (See N64-27126 19-13)

A method for determining the speeds in axial turbines and compressors is described. This method takes into account distortions of current lines in the meridional plane. The problem is solved without the use of successive approximations. In this method, the radial shift of current lines is assumed to vary according to the sine law; and the distortion of the field of the axial speeds, in the radial direction, is assumed to be small. These assumptions simplify the basic equations and permit the complete solution of the problem. R.T.K.

N64-27136* National Aeronautics and Space Administration, Washington, D.C.
HYPERSONIC BOUNDARY LAYER ON A BLUNTED FLAT PLATE [COUCHE LIMITE HYPERSONIQUE SUR UNE PLAQUE PLANE A BORD D'ATTAQUE EMOUSSE]
René Zolver Jun. 1964 23 p refs Transl. into ENGLISH from Rech. Aérospatiale (France), no. 97, 1963 p 3–10
(NASA-TT-F-9022)

The hypersonic interaction due to viscosity and bluntness is studied in the case of a blunted flat plate by the method of perturbations. The perfect fluid model considered at the beginning has a very weak pressure gradient. This limits the range of the study to the region situated far downstream. To complete this model a hyperbolic shock was chosen. The study is similar to Lees' and Probstein's in the case of a sharp flat plate; it shows that the interaction is characterized by the expression K $(\gamma, M_\infty)\overline{\chi}$, where $\overline{\chi}$ is the usual parameter of hypersonic pressure interaction and K is a coefficient proportional to $M_\infty^{-2/\gamma-1}$. At hypersonic speeds, the viscosity effect, when there is bluntness at the leading edge, is therefore considerably smaller than in the case of a sharp leading edge. Author

N64-27145 General Dynamics Corp., San Diego, Calif. General Atomic Div.
MOTION OF A GAS UNDER THE INFLUENCE OF A POINT-IMPACT SHOCK ON ITS SURFACE (AN EXPLOSION ON A SURFACE)
Yu. P. Raizer 28 May 1964 19 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), No. 1, 1963
(Contract DA-04-495-AMC-116(X); ARPA Order 71-62)
(GA-TR-5081; AD-440513)

The motion of a gas was examined, which initially occupied a half-space, bounded by a vacuum, under the influence of a point or line shock on its surface; or, equivalently, a point or line explosion on its surface. The problem of the point shock serves as an idealized model to describe the initial stage of propagation of a shock wave caused by the impact of a meteorite with a high velocity on the surface of a planet without an atmosphere, or of a micrometeorite on the surface of a scientific satellite. It is the two-dimensional analog of the well-known plane-impact shock problem. The case of two-dimensional self-similar motion is investigated. A qualitative picture of the motion is provided and a general limitation on the self-similarity parameter n in the decay law of the shock wave $p \sim M^{-n}$ (p is the pressure, M the mass engulfed by the shock wave) is established. An approximate solution to the problem is obtained, which generalizes to the two-dimensional case the exact solution for the one-dimensional plane problem. For the point shock, the value n = 1.07 for the adiabatic index γ = 1.205 is obtained. For the line shock, n = 1.14 for γ = 1.266. Author

N64-27193 Eidgenossische Technische Hochschule, Zurich (Switzerland) Inst. für Aerodynamik
THEORETICAL AND EXPERIMENTAL RESEARCH ON GAS DEPOSITS [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN AN GASLAGERN]
Valentin Stingelin 1963 83 p refs *Its* Mitt., no. 32 In GERMAN

The differential equation of aerodynamically lubricated bearings is derived. The known exact solutions of special cases of the equation are discussed. Solutions for the equation for the closed gas bearing (without slip-flow) and for the finitely wide gas bearing (with slip-flow) are derived and explained. Bearing reactions and characteristics are calculated, and various characteristics are displayed graphically. Lubricating-film changes-of-state and the influence of slip-flows on the bearing are discussed briefly. Experimental apparatus, procedures, and results are described. D.E.W.

N64-27202* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
BREAKUP OF VARIOUS LIQUID JETS BY SHOCK WAVES AND APPLICATIONS TO RESONANT COMBUSTION
Gerald Morrell and Frederick P. Povinelli Washington, NASA, Aug. 1964 14 p refs
(NASA-TN-D-2423) OTS: $0.50

Breakup times of liquid jets in crossflow were measured in a shock tube. Three jet diameters (0.052, 0.0785, and 0.157 in.) of water, n-heptane, liquid oxygen, and three glycerol-water mixtures were studied. Breakup time increased regularly with an increase in the ratio of jet radius to the gas velocity behind the shock front. A model based on mass removal from a liquid boundary layer agrees with the experimental data. A least-squares fit of measured and calculated breakup times permits quantitative estimates of breakup time or average mass removal rate for other conditions. With atomization assumed to be the rate-controlling process, it is shown how similarity parameters of three theories of combustion resonance may be evaluated in terms of engineering design variables. Author

N64-27210 France Ministere de l'Air, Paris
THEORETICAL METHODS FOR THE STUDY OF SUPERSONIC FLOWS [METHODES THEORIQUES D'ETUDE DES ECOULEMENTS SUPERSONIQUES]
P. Carriere Serv. de Doc. Sci. et Tech. de l'Armement, 1964 299 p refs In FRENCH *Its* Publ. Sci. et Tech. No. 399a

The theory and techniques of calculating supersonic nonviscous flow, using the method of characteristics, are explained. This method eliminates the need for resorting to linearization hypotheses. The presentation includes the one-dimensional theory of steady flow and the theory of shock waves, elementary theory of plane supersonic flow, explanation of the method of characteristics and some simple applications, the application of the method of characteristics to the calculation of flows of revolution, and a study of real-gas flow. M.P.G.

N64-27221 Deutsche Versuchsanstalt für Luft- und Raumfahrt, Aachen (W. Germany) Inst. für Theoretische Gasdynamik
MAGNETOGASDYNAMIC HYPERSONIC SIMULATION AT A MAGNETIC FIELD PARALLEL TO INCIDENT FLOW [MAGNETOGASDYNAMISCHE HYPERSCHALLAHNLICHKEIT BEI EINEM ZUR ANSTROMUNG PARALLELEN MAGNETFELD]
Martin Fiebig [1964] 6 p refs Repr. from Z. Flugwiss. (Braunschweig, W. Germany), v. 12, no. 1, 1964 In GERMAN; ENGLISH summary
(DVL-347)

The similarity laws for hypersonic flows are extended to flows with large magnetic Reynolds numbers assuming the magnetic field to be parallel to the flow direction, and the Alfvén speed to be at most of the same order of magnitude as the speed of sound. The equivalence principle according to Hayes on the relation of a steady two- or three-dimensional flow over slender bodies to an unsteady one- or two-dimensional flow remains valid; only the component of the magnetic field parallel to the u-component of the velocity occurs in the governing equations as an additional dependant variable. In the similarity law for slender bodies the Alfvén speed occurs as an additional parameter. The Mach number independence principle according to Oswatitsch, stating that the flow field is frozen at very high Mach numbers and for arbitrary body shapes independent of the specific Mach number, remains valid if, in addition to free-stream speed and density, the free-stream magnetic field is the same for comparable flows. The medium considered is a real, frictionless gas. Author

N64-27232 Virginia U., Charlottesville Research Labs. for the Engineering Sciences

LABORATORY INVESTIGATION OF THE BASIC NATURE OF LOW DENSITY GAS FLOW AT HIGH SPEEDS Quarterly Progress Report, 15 Jul.–15 Oct. 1963

A. R. Kuhlthau Jan. 1964 9 p refs

(Contract NOrd-18211)

(AST-3530-102-64U; AD-437859)

The apparatus for investigating molecular-beam scattering from a high-speed target rotor was assembled, and the rotor was operated at low speed. Molecular-beam scattering experiments were carried out with a stationary rotor, supported for one run by a magnetic field, and for a second run by mechanical props alone. The magnetic field was found to affect strongly the relation of scattered intensity to scattered angle. D.E.W.

N64-27279* Brown Engineering Co., Inc., Huntsville, Ala. Research Labs.

[CALCULATION OF THE INITIAL LIQUID LEVELS IN TWO INTERCONNECTED TANKS] Addendum to Technical Note R-70

B. H. Kavanaugh, Jr., J. B. Cox, and H. H. Seidel Feb. 1964 26 p

(Contract NAS8-5289)

(NASA-CR-56826; R-70A; R-70) OTS: $2.60 ph

Additions to a FORTRAN program, originally written to calculate the relative liquid levels in two interconnected tanks with different flow rates, are presented. There are two additions to the program—the first provides for the calculation of the initial liquid level when given the initial mass, and the second allows for positioning the interconnect line above the tank bottoms. P.V.E.

N64-27364* Consultants and Designers, Inc., Arlington, Va.

RELAXATION OF THE VIBRATIONAL ENERGY OF AIR MOLECULES BEHIND THE DIRECT SHOCK WAVE FRONT [RELKSATSIYA KOLEBATEL'NOY ENERGII MOLEKUL VOZDUKHA ZA FRONTOM PRYAMOY UDARNOY VOLNY]

N. A. Generalov, S. A. Losev, and A. I. Osipov 30 Jul. 1964 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 156, no. 5, 1964 p 1057–60

(Contract NAS5-3760)

(NASA-TT-F-8933; ST-AD-10182)

The equilibrium settling process by vibrational degrees of freedom of the molecules behind the shock-wave front takes place as a result of transformation of energy of colliding molecules into vibrational energy. However, at molecule collision, an exchange of vibration energy between molecules also takes place. Considering air as a binary mixture of diatomic gases N_2 and O_2, the conditions at which the vibrational energy exchange between the molecules N_2 and O_2 becomes substantial are given, and the distribution of the vibrational energy of the molecules behind the shock front are computed with and without consideration of the effects of exchange. D.S.G.

N64-27414 Canadian Armament Research and Development Establishment, Valcartier

NONEQUILIBRIUM ELECTRON DENSITY DISTRIBUTIONS IN HYPERSONIC AIRFLOWS AROUND BLUNT BODIES

D. Ellington and R. Tremblay (Computing Devices of Canada, Ltd.) Jul. 1964 29 p refs

(ARPA Order-133)

(CARDE-TR-503/64)

Electron density distributions in blunt body nonequilibrium hypersonic shock layers are computed by streamwise integration of the rate equation for the ionization reaction $N + O \rightleftarrows NO^+ + e$. The local species concentrations and thermodynamic state in the shock layer on which the calculations were based were obtained using an approximate method for nonequilibrium shock layer analysis. Author

N64-27490 Aerospace Corp., El Segundo, Calif. Aerodynamics and Propulsion Research Lab.

A NOTE ON SHOCK-SHOCK DIFFRACTION

J. W. Miles 13 May 1964 19 p refs

(Contract AF 04(695)-269)

(SSD-TDR-64-92; TDR-269(4230-30)-5; AD-603049)

Whitham's treatment of the shock-shock diffraction of a shock wave advancing into a uniform, quiescent region is extended to a shock wave advancing into a region of uniform flow on the assumption that all velocities are approximately parallel. The result is applied to diffraction of a blast wave by a thin wedge traveling at supersonic speed. The prediction of the pressure on the wedge, just behind the diffracted blast wave, is qualitatively satisfactory. Author

N64-27491 Aerospace Corp., San Bernardino, Calif.

WEAKLY IONIZED NONEQUILIBRIUM VISCOUS SHOCK LAYER AND ELECTROSTATIC PROBE CHARACTERISTICS

Paul M. Chung Jul. 1964 66 p refs

(Contract AF 04(695)-269)

(BSD-TDR-64-103; TDR-269(S4230-40)-1; AD-603168)

The electrochemical interactions between the hypersonic stream of weakly ionized gases and the stagnation region of electrically biased blunt bodies are analyzed. The analysis is based on a continuum description. From the study, typical current–potential relationships for electrostatic stagnation probes are obtained. The effects on the electrical characteristics of the finite rate collisional energy exchange between electrons and neutrals, and the nonequilibrium electron-ion recombination are studied. Particular attention is given to the electron temperature variations in the free stream, shock, and the shock layer. The classical electron saturation current is not usually attained. Author

N64-27559 Virginia U., Charlottesville School of Engineering and Applied Science

DISTRIBUTION OF SPEEDS IN A WELL-COLLIMATED MOLECULAR BEAM PRODUCED BY NEARLY-COLLISIONLESS EFFUSION. I: FIRST ORDER CORRECTION

Harold S. Morton, Jr. Jul. 1964 39 p refs Submitted for Publication

(Contract Nonr-3623(00); Proj. Squid)

(UVA-4-P-1; AD-443418)

The distribution of speeds in a well collimated effusion-type molecular beam is calculated through first order in the inverse Knudsen number (i.e., the ratio of source orifice diameter to molecular mean free path in the source) by solving the Bhatnagar–Gross–Krook constant-collision-time representation of the Boltzmann equation along the axis of symmetry. The fractional correction to the collisionless-limit (free-molecular) distribution is a complicated function of speed and is obtained by numerical integration. First-order Knudsen-number-dependent corrections to the free-molecular values are

given for streaming speed, thermal spread, stagnation temperature, Mach number, differential beam intensity, speed corresponding to maximum differential beam intensity, maximum differential beam intensity, and total beam intensity. These collisional corrections characterize a trend toward aerodynamic flow through the source orifice. Comparison with experimental results indicates that the calculated changes in the shape of the speed distribution function are substantially correct for Knudsen numbers as low as unity, but that the calculated change in intensity is appreciably too large. Author

N64-27565 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
FURTHER EXPERIMENTAL AND THEORETICAL STUDIES OF UNDEREXPANDED JETS NEAR THE MACH DISC
L. D'Attorre and F. Harshbarger Jul. 1964 45 p refs
(Contract AF 19(628)-3269; ARPA Order 363)
(GD/A-DBE-64-041; AD-444088)

Results of experimental flow visualization studies in the neighborhood of the Mach disc in underexpanded, inviscid jets are presented. The cases include sonic orifices, conical nozzles, Foelsch coordinate nozzles, and some full-scale, in-flight missile data. The exit to ambient static pressure ratios goes up to 300, and the ambient Mach numbers go up to 4.3. In each case studied the method of Bowyer, D'Attorre, and Yoshihara appears to provide a reasonable technique for predicting the size and axial position of the Mach disc. In addition it is shown that the curvature in the Mach disc must be considered it a consistent triple point calculation is to be made. Author

N64-27569 General Motors Corp., Santa Barbara, Calif. Defense Research Labs.
NONEQUILIBRIUM SCALING OF HIGH-ENTHALPY GAS FLOWS
Alan Q. Eschenroeder Jun. 1964 52 p refs
(Contract DA-04-495-ORD-3567(Z); ARPA Order 357-63; Proj. Defender)
(TR-64-02C; AD-444077)

The planning and interpreting of subscale reentry-flow experiments depend on the ability to employ similarities between model and prototype tests. The present work is a review of the understanding of such problems with special emphasis on applications to reentry-body airflows. A similarity transformation of the conservation laws is studied in terms of a framework for applications of scaling to specific cases. In particular, the cases of shock layer, boundary layer, and wake flows are considered in the light of results reported in the literature. Certain aspects of ion and radical kinetics are introduced in the discussions of airflows with and without contamination. The widespread applicability of binary reaction scaling to the various reactive flows is indicated. Author

N64-27571 California Inst. of Tech., Pasadena Graduate Aeronautical Labs.
PROPAGATION OF AN INITIAL DENSITY DISCONTINUITY
George Bienkowski 15 May 1964 98 p refs
(Contract DA-31-124-ARO(D)-33; Proj. Defender)
(Memo.-70; AD-442657)

The propagation of an initial one-dimensional density discontinuity is studied. The solution for times much shorter than the mean free time between collisions (i.e., collisionless), and the solution for times much longer than the mean free time (i.e., Euler) are functions of the same similarity variable x/t. They differ only in the details of the profiles. A method for evaluating the first effect of collisions is developed as an expansion in time with coefficients as functions of the similarity variable. The solutions are obtained in detail for both the Krook collision model and the exact collision integral for inverse fifth-power repulsion. Author

N64-27642 General Applied Science Labs., Inc., Westbury, N.Y.
CORRELATION OF HYPERSONIC WAKE TRANSITION DATA
Seymour L. Zeiberg 16 Oct. 1963 27 p refs
(Contract AF 19(628)-500; ARPA Order 166)
(ESD-TDR-64-424; AD-441183)

The available experimental transition data (obtained from the open literature) for the wakes of cones, spheres, wedges, cylinders, and sphere–cones are found to correlate with the free-stream Reynolds number (based on transition length) and the free-stream Mach number as the governing parameters. The data spread in this correlation are, at worst, a factor of about four. The cones (semivertex angles of 8° to 22.5°), wedges (semivertex angles of 10° and 22.5°), and sphere–cones (nose to base diameter of 1/2 and cone angle of 12.5°) group together, but are distinctly different from the spheres (1/8-in. to 1/2-in. diam) and cylinders, thereby indicating an effect of bluntness. A bluntness "correlation factor" (the square of the ratio of free stream to local wake Mach numbers) is deduced from the data, and shown to collapse the data for all bodies into one grouping. The cone, sphere, and sphere–cone data are insufficient to clearly define an effect of cone angle, cone base diameter, or sphere diameter. The wedge data (obtained by hot wire methods) indicate a dependence of transition on wedge angle. Author

N64-27655 Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
TWO-PHASE PRESSURE DROP IN PIPING COMPONENTS
D. E. Fitzsimmons 20 Mar. 1964 61 p refs
(Contract AT(45-1)-1350)
(HW-80970, Rev. 1) OTS: $1.75

Two-phase and single-phase pressure-drop data were obtained for horizontal 2-in. pipe and piping components that included 90° bends of 2-in., 3-in., and 10-in. radius of curvature; a branch tee; and valves of both gate and globe design. Also studied were sudden expansions and contractions involving 1-, 1 1/2-, and 3-in. pipe as well as an orifice with an opening equal to 0.8 of the pipe diameter. Data were obtained at mass velocities from 1,000,000 to 4,000,000 $lb_m/(hr)(ft^2)$ in the 2-in. pipe and at steam qualities up to 24% by weight. Most data were obtained at 1,200 psia while a selected number of experiments were performed at 800 and 1,600 psia. Single-phase pressure-drop data for all components were compared with handbook values. Two-phase pressure-drop data for the straight pipe were compared with values predicted by the homogeneous model, the Martinelli–Nelson correlation, and the Levy momentum exchange model. The two-phase pressure-drop data for the components were compared with the homogeneous model in most cases and were related to the results from the straight pipe. A correlation was developed to relate two-phase to single-phase pressure-drop ratios of the bends to the pressure-drop ratios for the straight pipe over the pressure range of 800 to 1,600 psia. Author

N64-27682 Rocket Propulsion Establishment, Westcott (Gt. Brit.)
TABLES FOR THE ISENTROPIC EXPANSION OF IDEAL GASES WITH CONSTANT RATIO OF SPECIFIC HEATS, γ PART X, γ = 1.400
C. Blake Jan. 1964 46 p
(RPE-TN-304; AD-441164)

The calculations were carried out on a Ferranti–Mercury digital computer, and the tables are duplicated from a stencil cut by a teleprinter typewriter direct from the output tape in order to eliminate transcription errors. Mathematical expressions and suggestions for using the tables are given. G.D.B.

N64-27708 Oceanics, Inc., Plainview, N.Y.
A STUDY OF HYDROELASTIC STABILITY OF PARTIALLY CAVITATED HYDROFOILS BY APPLICATION OF QUASI-STEADY THEORY
Paul Kaplan and Louis J. Zeckendorf Feb. 1964 43 p refs
(Contract NObs-88361)
(Rept.-64-10; AD-601010)

This report presents a stability analysis for partially cavitated hydrofoils, where the foil is represented by a flat plate. In the hydrodynamic force and moment representation, only the quasi-steady and apparent-mass contributions are retained; the wake effects, essential for unsteady theory, are neglected. The resulting flutter boundaries are compared to those obtained by applying the complete unsteady solution. It is shown that the behavior at low reduced frequencies is in agreement with the unsteady solution. In particular, the critical density ratio, which is (effectively) the lowest value of the density ratio at which flutter will occur, can be calculated exactly from the quasi-steady theory. Author

N64-27722 Virginia U., Charlottesville School of Engineering and Applied Science
DISTRIBUTION FUNCTION MEASUREMENTS IN RAREFIED GAS FLOW THROUGH AN ORIFICE
John E. Scott, Jr., Harold S. Morton, Jr., John A. Phipps, and John F. Moonan Jul. 1964 34 p refs Presented at the 4th Intern. Symp. on Rarefied Gas Dyn., Toronto, 14–17 Jul. 1964
(Contract Nonr-3623(00); Proj. Squid)
(UVA-5-P; AD-602977)

Distribution functions in argon and xenon beams that were formed by effusion through a plane orifice have been measured over a range of source density levels corresponding to source Knudsen numbers from 10 to 0.1. For source Knudsen numbers greater than about 5, it was not possible to detect directly the dependence of the differential beam intensity on source Knudsen number; i.e., departures from the Maxwell–Boltzmann distribution function corresponding to the collisionless limit were within the experimental error. As the source density is increased, the most probable beam speed is observed to increase, and the width of the distribution is observed to decrease. These effects, which are recognizable as the beginning of a trend away from free molecular flow toward continuum or aerodynamic flow through the source orifice, are clearly evident even when the source Knudsen number is as large as 3. Author

N64-27732 Stevens Inst. of Tech., Hoboken, N.J. Davidson Lab.
THE FORCE, MOMENT, AND HINGE-MOMENT CHARACTERISTICS OF SURFACE-PIERCING DIHEDRAL HYDROFOILS
R. P. Bernicker and P. W. Brown May 1964 39 p
(Contract Nonr-263(43))
(R-964; AD-601578)

This report presents the results of an experimental and theoretical study of the forces acting on a fully wetted, surface-piercing dihedral hydrofoil, fitted with trailing-edge hinged flaps. The tests cover a range of dihedral, flap deflection, and trim angles at several depths of submergence. Measurements include lift, drag, pitching moment about the midchord point at the foil apex, and the flap hinge moment. The three-dimensional lift data are reduced to equivalent sectional values with appropriate aspect ratio and depth correction factors, and shows good agreement with theoretical predictions for all aspect ratios and dihedrals tested. The effect of flap operation is linear in the flap deflection angle for the range of settings used. Drag data are found to be linearly dependent on the square of the lift coefficient, with the drag at zero lift a function of dihedral angle and aspect ratio. Values of the hinge moment coefficient for all dihedrals and aspect ratios are linear in the flap deflection angle, and results for the various test parameters indicate no direct dependence on aspect ratio. Author

N64-27759* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
TIME RESPONSE OF LIQUID-VAPOR INTERFACE AFTER ENTERING WEIGHTLESSNESS
Clifford E. Siegert, Donald A. Petrash, and Edward W. Otto Washington, NASA, Aug. 1964 13 p refs
(NASA-TN-D-2458) OTS: $0.50

An experimental study was conducted to determine the time required for the liquid-vapor interface to reach equilibrium in spherical, cylindrical, and annular tanks. The results of this study established a functional dependence of the time to reach equilibrium on the pertinent liquid parameters and system dimensions expected to influence the time response of the interface. The form of the equation that results, as determined from the experimental data, verifies the Weber number scaling parameter. Author

N64-27765 Stanford U., Calif.
A NOTE ON GRAVITY EFFECTS IN SUPERCAVITATING FLOW
Robert L. Street Mar. 1964 28 p refs
(Contract Nonr-225(56))
(TR-32; AD-601194)

Two approximations to the linearized theory for supercavitating flow about slender bodies are applied to the case of flow past a slender wedge in a transverse gravity field. The additional lift and moment forces arising as a result of the gravity field are calculated by theories that are expected to hold when the gravity effects are of first-order smallness consistent with the linearization approximations. The lift and moment coefficients obtained from the two approximations are in general quantitative agreement over the most important cavitation number range. The results obtained confirm the validity of the average-value approximation introduced by Parkin. Author

N64-27784 Stanford U., Calif.
FLOW LOSSES FOR HEAT EXCHANGERS WITH OBLIQUE FLOW HEADERS
Siegbert Wolf 19 Jun. 1964 94 p refs
(Contract Nonr-225(23))
(TR-60; AD-603128)

This report presents the results of an analytical investigation and an experimental program of turbulent flow through a screen matrix oriented parallel to the main flow. Inlet and exit headers were shaped so as to keep the pressure difference across the matrix constant and thereby insure uniform flow through the matrix. The investigation is restricted to an overall parallel flow situation. Estimates of the pressure drop across the matrix and header arrangement are compared to experimental values. Measured static pressure profiles in the headers are also presented and compared to theoretical profiles. Estimates of the obtained matrix velocity profile are made on the

basis of normal pressure differences. The report deals primarily with a single-pass, header-matrix arrangement. Author

N64-27785 Virginia U., Charlottesville Research Labs. for the Engineering Sciences
LABORATORY INVESTIGATION OF THE BASIC NATURE OF LOW DENSITY GAS FLOW AT HIGH SPEEDS Final Report, Apr. 1958–Jan. 15, 1964
A. R. Kuhlthau Apr. 1964 91 p refs
(Contract NOrd-18211)
(AST-3503-104-64U; AD-603273)

The basic nature of low-density gas flow at high speeds is discussed in terms of an experimental study of the reduction in drag on a rotating cylinder when held at moderately low pressure for extended periods of time. The free molecule Couette flow between the rotating cylinder is described. The development of an intense source of molecular beams for use in direct observations of gas–solid interactions is examined. The velocity analysis of molecular beams and the reflection of molecular beams from a rotating target are given. G.D.B.

N64-27800* Massachusetts Inst. of Tech., Cambridge
EXPERIMENTS ON JET FLOWS AND JET NOISE FAR-FIELD SPECTRA AND DIRECTIVITY PATTERNS
Erik Mollo-Christensen, Marc A. Kopin, and John R. Martuccelli Repr. from J. Fluid Mech., v. 18, Pt. 2, 1964 p 285–301 refs Previously published as ASRL-TR-1007; see N63-14191 09-27)
(Grant NsG-31-60)

The results of measurements of far-field sound emitted from jets are reported. The narrow-band power spectral density of the sound in the far field was measured for three jet diameters, three Mach numbers, and five angular positions. The intensity distribution of mean-square pressure fluctuation in the far field in several wide frequency ranges was also measured. The similarity relations found from the experiments are reported. Author

N64-27807* National Aeronautics and Space Administration. Amss Research Center, Moffett Field, Calif.
THEORETICAL LAMINAR CONVECTIVE HEAT TRANSFER AND BOUNDARY-LAYER CHARACTERISTICS ON CONES AT SPEEDS TO 24 KM/SEC
Gary T. Chapman Washington, NASA, Aug. 1964 66 p refs
(NASA-TN-D-2463) OTS: $1.75

Solutions of the equations of boundary layers without pressure gradient for air in chemical and thermodynamic equilibrium have been obtained for free-stream velocities from 3 to 24 km/sec, wall temperatures from 1,000° to 4,200° K, boundary-layer pressure levels from 0.1 to 10 atm, and values of the ratio of the kinetic energy per unit mass of the stream at the edge of the boundary layer to the total enthalpy (i.e., $u_e^2/2He$) of from 0 to 0.93. From these solutions the heat transfer, skin friction, boundary-layer thickness, displacement thickness, and momentum thickness were calculated. Besides the presentation of the solutions a procedure is outlined that illustrates how the use of the Crocco equation leads to very good first approximations to start the iteration procedure used in obtaining the present solutions. Author

N64-27843 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
A METHOD OF LIQUID JET BLOWOUT UNDER HIGH PRESSURE
A. A. Semerchan and M. A. Plotnikov 24 Apr. 1964 12 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 6, no. 8, 1963 p 82–87
(FTD-TT-64-252/1+2+4; AD-600817) OTS: $0.50

An apparatus was constructed that has a free liquid jet blowout at a velocity of 2,000 m/sec and higher. It consists of a pressure multiplier composed of two coaxial cylinders whose pistons are rigidly interconnected; consequently at piston equilibrium in any intermediate position, the pressure in the cylinders is inversely proportional to the areas of these pistons. A.W.

12 GEOPHYSICS

Includes auroral phenomena; upper atmosphere studies; oceanography; cartography; geodesy; and geomagnetism. *For Van Allen belts see*: 28 Space Radiation. *For related information see*: 05 Astronomy and Astrophysics; 21 Meteorology; and 29 Space Sciences.

N64-26962* National Aeronautics and Space Administration, Washington, D.C.
SOME DATA ON THE COMPOSITION OF THE UPPER LAYERS OF THE ATMOSPHERE
A. V. Fedynskiy *In its* Proc. of the Central Aerological Obs., No. 42 Jul. 1964 p 1–21 refs (See N64-26961 19-15) OTS: $3.50

A review is given of modern data on the neutral and ionic composition of the upper layers of the atmosphere, based on the results of rocket soundings. Author

N64-26994* Auckland U. (N. Zealand) Radio Res. Station
THE REFRACTION OF SATELLITE SIGNALS—I. THEORETICAL CALCULATIONS
J. E. Titheridge Repr. from J. Atmospheric and Terres. Phys., v. 26, no. 2, 1964 p 159–175 refs
(Grant NsG-54-60)

Calculations of the refraction affected by a radio wave passing through a spherically symmetrical ionosphere can be simplified by considering the equivalent flat layer. An effective height for this layer is calculated for parabolic and Chapman layers for a number of different frequencies and angles of incidence. Records of the elevation angle of signals received from an artificial satellite provide the same information as a sweep-frequency virtual height record for signals transmitted vertically through the ionosphere. At large zenith angles, when the ray just penetrates the ionosphere, the measured elevation angles can be used to calculate the scale height of the peak of the ionosphere. At small zenith angles the total electron content of the ionosphere can be determined by a method similar to that used in the analysis of doppler frequency shift and Faraday fading records. Author

N64-27039* Auckland U. (N.Zealand) Radio Res. Station
THE REFRACTION OF SATELLITE SIGNALS—II: EXPERIMENTAL RESULTS
J. E. Titheridge Repr. from J. Atmosph. Terr. Phys., v. 26, no. 12, 1964 p 177–191 refs
(Grant NsG-54-60)

Records of the elevation of the 20 Mc signal from the satellite Explorer 7 were used to calculate the scale height at the peak of the F-layer, and the total electron content of the

ionosphere, over a period of 16 months. The scale height, H showed a seasonal variation from 62 km in winter to 77 km in summer, at a mean sunspot number $\bar{R} = 60$. The variation with sunspot number in winter was given by $H = 54 (1 + 0.0023 \bar{R})$ km. There was a diurnal variation of about ±4 km in summer, but not in winter. The day-to-day variations were about ±20 percent, and were not related to the magnetic activity. The mean scale heights imply a temperature of 1060° K in winter and 1320° K in summer, at a height of about 350 km. The solar cycle variation implies a winter temperature of about 930° K at $\bar{R} = 0$, and 1360° K at $\bar{R} = 200$. The day-to-day fluctuations in the total electron content of the ionosphere and the sunspot cycle variation agreed with the variations shown by virtual height records. Author

N64-27081 Liege U. (Belgium)
CELESTIAL SPECTRA AND ATMOSPHERIC EFFECTS MAINLY IN THE INFRARED Annual Summary Report, 1 May 1963–31 May 1964
M. Migeotte 31 May 1964 28 p refs
(Contract AF 61(052)-685)
(AFCRL-64-569; AD-443424)

The data used to determine vertical ozone distributions are presented. A large-grating spectrometer was used in double pass with an intermediate adjustable slit for the following purposes: (1) observation of the profile from the solar strontium resonance line $^1P_1 - {}^1S_0$ at 4,607.34 A; (2) observations of the solar spectrum between 3,873.7 A and 3,875.3 A to identify the $C^{13} N^{14}$ lines that might be expected at 3,874.34 A; and 3,874.92 A; and (3) observation of the solar spectrum in the 7th order between 3,750 A, and 4,158 A. An improved interferometer of the Michelson type has been built and installed at the coudé focus of a 1-meter telescope. Very good interferograms of the 9.6μ band of telluric O_3 and of Venus and the Moon between 1μ and 3μ have been obtained. R.T.K.

N64-27133* Consultants and Designers, Inc., Arlington, Va.
INVESTIGATION OF CERTAIN TURBULENT FLOW PARAMETERS BY THE METHOD OF RADAR LOCATION OF METEOR TRAILS [ISSLEDOVANIYA NEKOTORYKH PARAMETROV TURBULENTNYKH DVIZHENIY METODOM RADIOLOKATSII METEORNYKH SLEDOV]
I. A. Delov, M. F. Lagutin, and I. A. Lysenko 17 Jul. 1964 11 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Radiofiz. (Gor'kiy), v. 7, no. 2, 1964 p 225–231
(Contract NAS5-2078)
(NASA-TT-F-8924; ST-IM-10171)

This paper discusses the results of experimental investigations of turbulent motions in the meteor zone by the method of radar location of meteor trails. The magnitude of the basic statistical parameters characterizing the turbulent motion is estimated. The daily variations of some of the parameters are investigated. Although the parameters of turbulent motion, found in this work, are by their order of magnitude near those found in previous works, the radar location method applied here on the basis of local properties of turbulence provides a more correct estimate of the values of ϵ. The presence of daily variations of a series of statistical turbulence parameters provides the basis of assuming that the "intensity" of turbulence in the meteor zone is controlled by the sun. Author

N64-27180 Nagoya U. (Japan) Research Inst. of Atmospherics
PROCEEDINGS OF THE RESEARCH INSTITUTE OF ATMOSPHERICS, NAGOYA UNIVERSITY, VOLUME II
A. Kimpara, H. Ishikawa, K. Sao, H. Tanaka, and A. Iwai, ed. Jan. 1964 62 p refs

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4. THE OBSERVATION OF VLF EMISSIONS AT MOSHIRI A. Iwai, J. Outsu, and Y. Tanaka p 29–40 refs (See N64-27184 19-12)
5. ELEVEN-YEAR VARIATION OF THE SPECTRUM OF SOLAR RADIO EMISSION ON THE MICROWAVE REGION H. Tanaka p 41–51 refs (See N64-27185 19-28)
6. REMARKS ON THE ERDANTENNE K. Sao, M. Takagi, and H. Jindo p 57–59 refs

N64-27181 Nagoya U. (Japan) Research Inst. of Atmospherics
ELECTROMAGNETIC ENERGY RADIATED FROM LIGHTNING
Atsushi Kimpara *In its* Proc. of the Res. Inst. of Atmospherics, Nagoya U., Vol. 11 Jan. 1964 p 1–11 refs Presented at the Third Intern. Conf. of Atmospheric and Space Elec., Montreux, Switzerland, 1963 (See N64-27180 19-12)

The purpose of this paper is to survey the study recently developed on the electromagnetic energy radiated from lightning, i.e., atmospherics, not including propagation. Characteristics of the electrostatic, induction, and radiation fields of lightning are fully described, including the frequency spectrum in the neighborhood of the source. Author

N64-27182 Nagoya U. (Japan) Research Inst. of Atmospherics
LIGHTNING FLASHES AND ATMOSPHERICS
Atsushi Kimpara *In its* Proc. of the Res. Inst. of Atmospherics, Nagoya U., Vol. 11 Jan. 1964 p 13–18 refs Presented at Comm. IV of XIVth Gen. Assembly of URSI, Tokyo, 1963 (See N64-27180 19-12)

Extensive studies on characteristics of atmospherics radiated from lightning discharges were made experimentally and theoretically; frequency spectra were obtained for almost all frequency ranges from ELF to UHF for every stage of ground and cloud discharges. Propagation characteristics of VLF waves and atmospherics were made clear for ELF and VLF ranges; e.g., the attenuation was almost the same for frequency range 4 to 10 kc and about 7 to 9 db/1,000 km at 6 kc and decreased to about 1 to 3 db/1,000 km on frequencies higher than 10 kc for atmospherics, and these values are fairly well coincident with those obtained for radio waves. The intensity and phase characteristics of VLF waves and atmospherics were investigated at normal and abnormal propagation conditions such as during solar flares, geomagnetic storms, nuclear explosions, etc. Author

N64-27183 Nagoya U. (Japan) Research Inst. of Atmospherics
DISTRIBUTIONS OF PULSE DURATION IN THE POISSON NOISE AND ATMOSPHERIC NOISE
Taketosi Nakai *In its* Proc. of the Res. Inst. of Atmospherics, Nagoya U., Vol. 11 Jan. 1964 p 19–27 ref (See N64-27180 19-12)

A simple model is taken from the time series of pulses of rectangular form that resulted from amplifying and limiting the atmospheric noise envelopes at a given voltage level. This

model is the Poisson noise process in which the original pulses with a constant duration arrive at the time spacings determined by the Poisson distribution law. The probability density function and distribution function of duration are derived by the method of the characteristic function for the K-multiple pulses and by all the observed pulses in the Poisson noise process. These functions are characterized by the product of the average number per second and the constant duration of the original pulses. Author

N64-27184 Nagoya U. (Japan) Research Inst. of Atmospherics
THE OBSERVATION OF VLF EMISSIONS AT MOSHIRI
Akira Iwai, Jinsuke Outsu, and Yoshihito Tanaka *In its* Proc. of the Res. Inst. of Atmospherics, Nagoya U., Vol. 11 Jan. 1964 p 29–40 refs (See N64-27180 19-12)

Methods of making observations are outlined, and some results obtained are presented. These results indicate that the VLF emissions are observable at geomagnetic latitudes as low as 34°, and that the majority of the VLF emissions are of the hiss type; however, during severe magnetic storms, choruses are also observed. The correlation between the occurrence of rate of noise burst and geomagnetic activity, measured by daily k-index and magnetic storms, is very close. The type of geomagnetic pulsation does not have as close a correlation, and the peak flux density of noise burst does not appear to depend directly on geomagnetic activity. P.V.E.

N64-27200* Alaska U., College Geophysical Inst.
THE DEVELOPMENT OF THE AURORAL SUBSTORM
S.-I. Akasofu Oxford, N.Y., Pergamon [1964] Repr. from Planet. Space Sci., v. 12, 1954 p 273–282 refs
(Grant NsG-201-62)

A working model of simultaneous auroral activity over the entire polar region is presented in terms of the auroral substorm. The substorm has two characteristic phases—an expansive phase and a recovery phase. Each phase is divided into three stages, and characteristic auroral displays over the entire polar region during each stage are described in detail. Further, all major features seen at a single station are combined into a consistent picture of large-scale auroral activity. Author

N64-27209* Chicago U., Ill. Enrico Fermi Inst. for Nuclear Studies
MAGNETOSPHERIC CUTOFF FOR 1.5-MeV EXTRATERRESTRIAL PROTONS
C. Y. Fan, J. A. Simpson, and Edward C. Stone Repr. from Phys. Rev. Letters, v. 12, no. 11, 16 Mar. 1964 p 269–271 refs
(Grant NsG-179-61)

Results are reported from an oriented satellite whose orbit passed over the geomagnetic pole carrying detectors that were sensitive to 1.5-Mev protons from both the vertical and horizontal directions and were insensitive to electrons. It is concluded that protons detected in high latitudes are from solar flares, and that magnetosphere interaction with the solar wind gives rise to cutoff energy discrepancies and to the diffuse cutoff on the sun side. D.E.W.

N64-27257* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A COMPILATION OF MAGNETIC OBSERVATORIES
Joseph C. Cain and Christopher D. Wright 5 Mar. 1964 47 p
(NASA-TM-X-55017; X-612-64-73) OTS: $4.60 ph

This compilation of current and past magnetic observatories should be useful in assessing data accrued during the IQSY and for studying variations and secular changes of the field from past data. The criterion for inclusion of extinct observatories is that they operated for two years or more, recording both absolute values and daily variation of the vector field. A currently operating observatory is included if it has been continuously recording for more than a few months and plans to continue through the IQSY. The tables of observatories are presented in order of geographic latitude, sponsoring country, and mnemonic code. D.S.G.

N64-27273* Geophysics Corp. of America, Bedford, Mass.
EXPERIMENTAL STUDY ON THE DYNAMICS AND STRUCTURE OF THE UPPER ATMOSPHERE Final Report
Jun. 1964 107 p refs
(Contract NASw-712)
(NASA-CR-58206; GCA-TR-64-10-N) OTS: $9.10 ph

The purpose of this paper is to measure the upperatmospheric winds and diffusivity from analysis of the motions of sodium and lithium vapor trails ejected from sounding rockets during twilight. A total of nine vapor-trail payloads were prepared for three different launch sites. Also included in the above objective was the investigation of atmospheric turbulence and temperatures by a study of the vapor trails. Triangulation methods were used to determine the winds defined as the direction and rate of the vapor-trail movement. Densitometer measurements of the trail width are used to determine expansion characteristics and diffusion coefficients. Analysis of the data taken from photographs of the vapor trails gave a model of the method for determining the structure and dynamics of the upperatmospheric winds, which correlated with the radio–meteor method. A.L.B.

N64-27274* Hawaii Inst. of Geophysics, Honolulu
[AIRGLOW AND ZODIACAL LIGHT RESEARCH] Sixth Semiannual Status Report, 1 Oct. 1963–31 Mar. 1964
Walter R. Steiger 6 Jul. 1964 3 p
(Grant NsG-135-61)
(NASA-CR-56881) OTS: $1.10 ph

Zodiacal light observations were continued. These include full-night observations at the local zenith to obtain reliable data on the zodiacal light polarization at large solar elongation angles, and zenith-to-horizon observations of selected stars for atmospheric extinction measurements. The airglow observation program continued its monochromatic all-sky observations λ5,577, λ5,893, and λ6,300, as well as broadband observations in the region of λ8,000. Absolute photometry of the zenith was carried out at λ5,577, λ5,893, λ6,300, and λ5,300. Observations were obtained for at least 2 hours on 58 nights and 6 hours or more on 46 nights of the 104 scheduled observing nights. A new digital system for the zenith photometer was installed, and a new set of interference filters in the zenith photometer was completed. R.T.K.

N64-27275* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INFRARED HORIZON OF THE PLANET EARTH
R. A. Hanel, W. R. Bandeen, and B. J. Conrath Aug. 1962 37 p refs
(NASA-TM-X-51732; X-650-62-164) OTS: $3.60 ph

Horizon sensors are essential elements in the orientation systems of many space vehicles and satellites. The design of horizon sensors, as well as an evaluation of their capabilities and limitations requires a knowledge of the spectral radiance emitted by the earth. This report investigates the discontinuity between the surface, the atmosphere, and outer space for various latitudinal, seasonal, climatic, and meteorological conditions. Calculations are carried out for five spectral intervals—the water vapor band from 6.33μ to 6.85μ, the ozone band

from 8.9μ to 10.1μ, the atmospheric window from 10.75μ to 11.75μ, the carbon dioxide band from 14μ to 16μ, and finally the rotational water vapor band from 21μ to 125μ. The superior properties of the carbon dioxide band and the rotational water vapor region for horizon sensor purposes are shown. Author

N64-27276* Consultants and Designers, Inc., Arlington, Va.
INVESTIGATION OF THE STATE OF THE LOWER IONOSPHERE DURING SUNRISE
K. U. Wagner 8 May 1964 21 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 4, no. 1, 1964 p 90–101
(Contract NAS5-2078)
(NASA-TT-F-8695; ST-AT-10-132)

During the time between sunrise at the altitude of 100 km and sunrise at the ground, the lower ionosphere is not in the state of equilibrium. An attempt was made to calculate the electron density inside the unsteady ionosphere. For the purpose of calculation, it was assumed that the process of attachment leads to the state of equilibrium much more rapidly than does the recombination. Analysis of sunrise effects with the aid of field intensity registration of commercial transmitters in the range of long and ultralong radiowaves (16 to 300 kc/s) leads to the corollary that these effects can be explained by the formation of electrons from negative ions under the effect of light. Author

N64-27353* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York, N.Y.
A NEUTRAL-POINT EXPANSION OF THE IDEAL MAGNETOSPHERE
Ronald Blum Repr. from J. Geophys. Res., v. 69, no. 9, 1 May 1964 p 1765–1768 refs
(NASA-RP-274)

The idealized model of the geomagnetic field–solar wind interaction yields a singular (neutral) point on the magnetopause at which the magnetic field vanishes. If the fields are expanded in a power series around this point, including quadratic terms, an approximate equation of the magnetopause can be derived in a small neighborhood of the neutral point that is consistent with the idealized boundary conditions to fourth order. The additional pressure due to multiple reflections of particles in this neighborhood is then considered, and it is shown that less than a 4-percent correction to the single-reflection pressure condition is necessary. Author

N64-27355* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE WORLD MAGNETIC SURVEY
J. P. Heppner Dordrecht, Holland, D. Reidel [1963] 42 p refs Repr. from Space Sci. Rev. (Dordrecht), v. 2, 1963 p 315–354
(NASA-RP-277)

The mathematical and graphical description of the earth's main field has been, and is, a data-limited problem. The World Magnetic Survey (WMS) is an endeavor to minimize this limitation by rapidly and comprehensively blanketing the earth with magnetic field measurements. Satellite surveys, which will play a key role in the WMS, are the principal topic of this paper. Existing magnetic field descriptions, the expected results from new surveys, and the methods of obtaining these results with the POGO satellite are emphasized. Author

N64-27368* National Aeronautics and Space Administration, Washington, D.C.
POSSIBILITY OF DETECTING HIGH ENERGY PARTICLES IN THE UPPER ATMOSPHERE BY OBSERVATIONS OF THE NIGHT AIRGLOW. [POSSIBILITE DE DETECTION DE PARTICULES DE GRANDE ENERGIE DANS LA HAUTE ATMOSPHERE PAR DES OBSERVATIONS DE LA LUMINESCENCE NOCTURNE ATMOSPHERIOUE]
Daniel Barbier Jul. 1964 11 p refs Transl. into ENGLISH of a Paper Presented at the COSPAR Meeting, Florence, May 1964
(NASA-TT-F-9031)

The excitation of high latitude auroras (i.e., classical auroras whose prime cause is the existence of high energy particles in the upper atmosphere) is studied. The problem of whether low latitude auroras form a transition between normal auroras and night airglow is examined. It is concluded that this is not the case at all; as is generally recognized, the airglow belongs to an entirely different category of phenomena. Calculations are cited that make it possible to determine the maximum values of fluxes of energetic particles in the upper atmosphere by observing some lines of the airglow. Simultaneous observations of the intensity of the 6300 line and of the electronic profiles of the ionosphere show that, at least in a station of low latitude, the structure of the F-layer is primarily determined by the movements of ionized matter. This casts doubt on the importance of fluxes of fast particles in maintaining the nocturnal ionosphere. Author

N64-27373 National Physical Lab., New Delhi (India) Radio Propagation Unit
IONOSPHERIC DATA, APRIL 1963
[1963] 61 p
(RRC-A95)

A coordinated publication collecting ionospheric data from eight stations in India is issued monthly. These observations are supplemented with geophysical data of interest for ionospheric studies. D.S.G.

N64-27374 National Physical Lab., New Delhi (India) Radio Propagation Unit
IONOSPHERIC DATA, MARCH 1963
[1963] 61 p
(RRC-A94)

The ionospheric data presented were collected at stations in Delhi, Ahmedabad, Haringhata, Bombay, Madras, Tiruchirapalli, Kodaikanal, and Trivandrum. Data are given for each day of the month, including information on the E- and F-layers of the atmosphere as well as solar and magnetic data. R.T.K.

N64-27440 Stanford U., Calif. Rock Magnetics Research Group
ANOMALOUS REMANENT MAGNETIZATION OF SOME KLAMATH RIVER ANDESITES, PART I Final Report
Donald F. Heinrichs Jan. 1964 58 p refs
(Contract AF 19(604)-8043)
(AFCRL-64-97(1); AD-602294)

A section of the Western Cascade series of Tertiary volcanics with anomalous remanent magnetization directions was sampled. Five anomalous flows and three stable flows are studied in detail. The direction and intensity of the natural remanent magnetization (NRM) is measured before and after demagnetization experiments. A study of the mineralogy shows that all

the anomalous flows are slightly altered (propylitized) and that four of the five flows have a well-developed flow structure. Different mineral parameters were examined and plotted against variations in the magnetic properties of the flows, but the exact mechanism of the formation of the anomalous magnetic directions remains unknown. The remanent magnetization measured in the anomalous flows is a chemical remanent magnetization and not a thermoremanent magnetization as is measured in most flows from the Western Cascade series. The direction of the remanent magnetization vector is not in the direction the paleomagnetic field but is controlled by the propylitization of the flows. Author

N64-27521 HRB-Singer, Inc., State College, Pa. Technical Information Center
BIBLIOGRAPHY ON THE IONOSPHERE AND UPPER ATMOSPHERE, 1961–1963
Benita Bulera Palluconi Jun. 1964 236 p refs
(B-4; AD-441450)

N64-27537 Michigan U., Ann Arbor Office of Research Administration
THEORETICAL STUDY OF ATMOSPHERIC PRESSURE PULSE PROPAGATION Final Report, 1 Mar. 1962–29 Feb. 1964
David B. Van Hulsteyn Mar. 1964 26 p refs
(Contract AF 19(628)-304)
(AFCRL-64-424; Rept.-5033-1-F; AD-601386)

An investigation to formulate a theoretical explanation of the nature and propagation characteristics of atmospheric pressure pulses generated by nuclear explosions is discussed. The main result of the investigation was the determination of the pressure-wave form at a great distance from an explosive source. P.V.E.

N64-27538 Alaska U., College Geophysical Inst.
AN INVESTIGATION OF SOLAR INDUCED PHENOMENA AT MAGNETICALLY CONJUGATE POINTS, PART 2 (CHAPTERS IV–IX) Final Report
Eugene M. Wescott and Keith B. Mather May 1964 158 p refs For Part I see N64-26220 18-12
(Contract AF 19(628)-2779)
(UAG-R146, Pt. 2; AFCRL-64-274; Pt. 2; AD-602297)

The results of a comprehensive study of solar induced geophysical phenomena at pairs of magnetically conjugate stations are presented. Magnetic variations (except Sq), telluric currents, ionospheric absorption, visual auroras, VLF and ELF emissions, and auroral X-rays occur in a similar manner in conjugate areas—in time, form, and amplitude. The magnetic variations and closely related telluric currents are discussed in the greatest detail. Many aspects of magnetic conjugacy were found to relate to the occurrence of electrojets in conjugate patterns. Some phenomena may result from hydromagnetic waves in the magnetosphere and others from ionospheric current systems. Visual auroras, and other phenomena closely related to charged particle precipitation occur in similar simultaneous displays in conjugate areas. Author

N64-27543 Ohio State U. Research Foundation, Columbus Inst. of Geodesy, Photogrammetry and Cartography
DEFLECTIONS OF THE VERTICAL CAUSED BY TOPOGRAPHIC MASSES IN THE NEAREST NEIGHBORHOOD OF THE POINT Report No. 9
G. L. Strang Van Hees Mar. 1964 22 p refs
(Contract AF 19(628)-2771)
(AFCRL-64-320; AD-600670)

The order of magnitude of the influence of nearby topography on the deflections of the vertical is investigated. The influence is computed for several points for an area with a radius of about 5 km around the point. This shows that the influence of the nearest neighborhood can reach considerable amounts and may never be neglected in mountainous areas. Further formulas are derived for the influence of the central zone on the deflections, assuming that the point lies on a slope. Some models are studied in order to get a more general insight about the deflections caused by topography. Author

N64-27641 Bowling Green State U., Ohio
ELECTRONIC MEASUREMENT AND ANALYSIS OF GEOGRAPHIC PHENOMENA Final Report
James P. Latham 1 Jun. 1964 36 p
(Contract Nonr-3004(01))
(AD-601222)

Results are summarized of a program to develop methods and systems for analyzing the distribution of geographic phenomena by means of rigorous measurement, and to evaluate the feasibility of improving such methods through the use of instrumented systems of data collection, image analysis, measurement, data processing, and statistical or graphical output. Accomplishments of this program include the development and demonstration of the Rotated Parallel Traverses Method and the Radiated Traverses Method. Other general research accomplishments are summarized, their contribution to the field of geography stated, and possible naval applications suggested. Abstracts of reports, papers, and publications completed under this program are included. M.P.G.

N64-27756* Alaska U., College Geophysical Inst.
ON THE ASYMMETRIC DEVELOPMENT OF MAGNETIC STORM FIELDS IN LOW AND MIDDLE LATITUDES
S.-I Akasofu and S. Chapman Repr. from Planet. Space Sci., V. 12, Jun. 1964 p 607–626 refs
(Grant NsG-201-62)

Analysis is presented of the disturbance field of certain magnetic storms, including that of 13 September 1957, showing that there must be a fairly steady current system, partly external and partly ionospheric, which contributes a substantial portion of the asymmetry in the low and middle latitude storm field, independent of the growth and decay of auroral electrojets. A new model electric current system is presented to account for such an asymmetry. It is suggested that there is a gap in the ring current belt on the night side, and that the ring current is closed through the ionosphere. Author

13 HEAT TRANSFER AND THERMODYNAMICS

Includes ablation; cooling; heating; and other thermal effects. *For aerothermodynamics see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; and 03 Aerodynamics of Wings, Rotors, and Control Surfaces. *For combustion see*: 26 Propellants and Combustion. *For related information see*: 11 Fluid Mechanics.

N64-27040 Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services
RESULTS OF THE EXPERIMENTAL INVESTIGATION OF CONTRACT HEATING-EXCHANGE BETWEEN PLANE METAL SURFACES [REZUL'TATI EKSPERIMANTNOGO DOSLIDZHENNYA KONTAKTNOGO TEPLOOBMINU MIZH METALEVIMI PLOSKIMI POVERKHNYAMI]

V. S. Miller Mar. 1964 12 p refs Transl. into ENGLISH from Akad. Nauk Ukr. RSR, Inst. Teploenerg. Zb. Prats (USSR), v. 20, 1960 p 44–53
(TIL/T-5407)

Influences of surface finish, pressure, ambient medium, and contacting materials were examined experimentally. The thermal resistance of contact was observed as a temperature jump. Both pressure and finish had appreciable effects on the resistance, especially pressure in the lower values. Initial laws for contact heat exchange allow the possibility of deducing some analytical relationships and promoting more intensive studies. Author

N64-27051 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
CONTACT THERMAL RESISTANCE
Konomo Sonokama (Japan Atomic Energy Res. Inst.) 13 Jul. 1964 36 p refs Transl. into ENGLISH from J. Japan Soc. Mech. Engrs., v. 64, no. 505, 1961 p 240–250
(RSIC-215; AD-443429)

Experiments of discontinuity in contant temperature because of the existence of a thermal resistance at the surface of two solids are reported. This phenomenon is known as contact thermal resistance. Results and graphs are presented to show the effects of contact pressure, surface roughness, hardness, mean temperature of contacting surface, void material, pressure of gas in void, and surface oxidation on contact thermal resistance. J.L.C.

N64-27123* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
LAMINAR AND TURBULENT HYDROGEN HEAT TRANSFER AND FRICTION COEFFICIENTS OVER PARALLEL PLATES AT 5000° R
Jack G. Slaby, William L. Maag, and Byron L. Siegel Washington, NASA, Aug. 1964 30 p refs
(NASA-TN-D-2435) OTS: $0.75

Local heat-transfer coefficients and average friction factors were obtained experimentally for hydrogen flowing over parallel tungsten plates heated electrically to 5,000° R with an outlet hydrogen temperature as high as 3,500° R. For these experiments, the ratio of length to equivalent diameter was 74, and the modified Reynolds number varied from 1,255 to 12,500 with the fluid properties evaluated at the film temperature. The ratio of surface to bulk-gas temperature extended to 3.0, and the maximum local heat flux was 2.75 Btu/sec.-sq in. The local heat-transfer coefficients for turbulent flow were correlated by a Dittus–Boelter-type equation. The experimental laminar-flow heat-transfer data showed good agreement with an analytical study of a developing laminar-flow region. The thermal entrance length required for a constant Nusselt number in laminar flow depended on the local modified film Reynolds number, which decreased as much as a factor of 3 from entrance to exit. An experimental value of Nusselt number equal to 9.0 was determined for fully developed laminar flow across parallel plates. The experimental friction factors in the laminar entrance region of parallel plates agreed with average analytical friction factors in the laminar entrance region of a tube. Average isothermal turbulent friction factors correlated with the Kármán–Nikuradse line. With the addition of heat, however, the friction factors were progressively higher than the Kármán–Nikuradse line. Author

N64-27126 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
HEAT POWER ENGINEERING Selected Articles
8 Mar. 1963 21 p refs Transl. into ENGLISH from Teploenerg. (Moscow), no. 7, 1962 p 50–53, 77–80
(FTD-TT-62-1784/1+2; AD-299413)

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2. HEAT TRANSFER IN TURBINE GRIDS L. M. Zysina-Molozhen, M. P. Polyak, and I. B. Uskov p 11–18 refs (See N64-27128 19-13)

N64-27128 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
HEAT TRANSFER IN TURBINE GRIDS
L. M. Zysina-Molozhen, M. P. Polyak, and I. B. Uskov *In its* Heat Power Eng. 8 Mar. 1963 p 11–18 refs (See N64-27126 19-13)

The results of the calculation of the heat transfer and temperature fields of gas turbine vanes are reported. The inconstancy of the heat-transfer coefficient along the contour of the turbine, and its variability with the change in the lateral cross section and height of the turbine are considered. A comparison of theoretical and experimental data is given. R.T.K.

N64-27269* Aeronca Mfg. Corp., Middletown, Ohio
RESEARCH AND DEVELOPMENT OF S-IC HEAT SHIELD PANELS Monthly Report No. 3
D. Y. Potter 14 May 1963 51 p
(Contract NAS8-5221)
(NASA-CR-58045; ER-669; ACN-123) OTS: $5.60 ph

Transient heat-transfer analyses of the Saturn-IC base heat-shield panel are presented. The digital-computer program for thermal analysis is discussed briefly, and equations are given. Design-point analysis and parametric analysis are discussed; results are displayed graphically. A stress analysis of the panel is presented in detail. D.E.W.

N64-27297* Minnesota U., Minneapolis Heat Transfer Lab.
PRANDTL NUMBER MEASUREMENTS AND THERMAL CONDUCTIVITY, VISCOSITY PREDICTIONS FOR AIR, HELIUM, AND AIR-HELIUM MIXTURES
W. E. Ibele, J. L. Novotny, and E. R. G. Eckert Dec. 1963 47 p refs
(Contract NASw-3)
(NASA-CR-55273) OTS: $4.60 ph

Prandtl number measurements of air, helium, and air–helium mixtures have been performed over a temperature range from 300° to 700° K. Various methods of predicting the thermal conductivity and viscosity of binary mixtures were also investigated, and results obtained by use of these methods were compared with the experimental results. The method set forth by Hirschfelder, Curtiss, and Bird, which uses the Lennard–Jones intermolecular potential, was selected, and force constants determined from experimental data were applied for predicting thermal conductivity and viscosity. Dimensionless conductivities, viscosities, and Prandtl numbers were calculated over the temperature range of 200° to 3,000° K for mixtures ranging from pure air to pure helium. Author

N64-27315* Avco-Everett Research Lab., Everett, Mass.
HEAT TRANSFER MEASUREMENTS IN PARTIALLY IONIZED GASES

P. H. Rose and J. O. Stankevics Jul. 1964 47 p refs
(Contract NASw-748)
(NASA-CR-58049; Avco-Everett Res. Note-464) OTS: $4.60 ph

A number of theoretical and experimental investigations were published on the subject of convective energy transport in a high-temperature partially ionized gas. Although, in general, a fair degree of understanding of this process is now available, certain uncertainties have arisen, particularly with respect to the effect of the surface material of the heat-transfer gage. This experimental investigation brings a new technique of making heat-transfer measurements to bear on this problem. The infrared-heat-transfer gage was adapted to the problems peculiar to this experiment. An analysis is presented demonstrating the response required of the measurement for accurate heat-transfer measurements to be made within the limited test times available. The difficulties of adapting the gage to the requirements are described—in particular, the sensitivity, opacity, and adherence of the gage to the MgO window. The calibration of the absolute magnitude of the output of the infrared cell, as well as the response time of the measuring system, is described in detail. The response of the gage to the heat transfer encountered in both the shock tube end wall and on a model is discussed, with emphasis on the identification of radiative heat-transfer effects. Author

N64-27346 Witwatersrand U., Johannesburg (Union of South Africa)
RESEARCH ON BOILING. A BIBLIOGRAPHY
Anita Van Hoogstraten, comp. Jan. 1964 84 p refs
(Rept.-19)

N64-27356* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
USE OF TEMPERATURE-SENSITIVE COATINGS FOR OBTAINING QUANTITATIVE AERODYNAMIC HEAT-TRANSFER DATA
Robert A. Jones and James L. Hunt Repr. AIAA J., v. 2, no. 7 3 p refs
(NASA-CR-278)

A method was developed whereby quantitative heat-transfer rates can be determined on arbitrary shapes without the use of a reference sphere. In this method, the heat-transfer rates depend upon the time required for the phase change to occur and upon the thermal properties of the model material. Results were obtained showing that this method can be useful and that reasonably accurate data can be obtained. In this method, a very thin coating of this phase-change material (Tempilaq) is sprayed over the model, and then the model is rapidly injected into the steady airstream; the times at which the phase change occurs for various locations on the model are determined by motion-picture photography. Some examples of patterns obtained by this method are given. R.T.K.

N64-27394* Little (Arthur D.) Inc., Cambridge, Mass.
THERMAL SCALE MODELING OF SPACECRAFT: AN EXPERIMENTAL INVESTIGATION
Arthur A. Fowle, Frank Gabron, and Robert W. Johnson 28 Jun. 1963 110 p refs
(Contract JPL-950252)
(NASA-CR-56624; C-64924) OTS: $9.10

Two sets of thermal scaling laws appropriate to spacecraft are discussed. One requires that the model and prototype be fabricated from materials having identical thermal properties, and a second requires that the thermal conductivities differ so that the temperatures of the model can be made identical to those of the prototype at equivalent geometric locations. An experimental investigation was carried out to determine the practicability of applying the second set of thermal scaling laws to a typical spacecraft. A prototype and two geometric models were fabricated, and the temperature distributions were measured at steady-state conditions in a space-simulation chamber. Results are presented for tests at two internal power-dissipation levels, and for tests in which two-dimensional and three-dimensional heat-flow patterns were established. D.S.G.

N64-27505* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT-TRANSFER RATES AND ABLATION ON A BLUNTED CYLINDER-FLARE CONFIGURATION IN FREE FLIGHT UP TO A MACH NUMBER OF 8.98
Clyde W. Winters Washington, NASA, Aug. 1964 29 p refs
(NASA-TN-D-2383) OTS: $0.75

A three-stage rocket-propelled vehicle system was flown to a maximum Mach 8.98 to determine the ablation characteristics of several ablative materials and the heating rates over various sections of a blunted cylinder-flare configuration. Continuous in-flight measurements were made over the Teflon nose cone in which ablation sensors were installed. The ablated-length measurements were in close agreement with analytical predictions. In-flight temperature measurements were also made over the inner surface of uncoated Inconel sections (serving as calorimeters) behind the nose cone as well as over the inner surface of sections coated with several ablative materials. These measurements were used to calculate the heating rates for the analysis of the ablative materials. Author

N64-27506* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HEAT-TRANSFER MEASUREMENTS AT A MACH NUMBER OF 8 IN THE VICINITY OF A 90° INTERIOR CORNER ALINED WITH THE FREE-STREAM VELOCITY
P. Calvin Stainback Washington, NASA, Aug. 1964 42 p refs
(NASA-TN-D-2417)

An experimental investigation was conducted to determine the influence of the interaction of the flow field with the boundary layer on the heat transfer in the vicinity of an interior corner formed by the normal intersection of two planes when the line of intersection was aligned with the free-stream velocity. The investigation was made at a nominal Mach number of 8, and the nominal unit Reynolds number per foot was varied from 0.23×10^6 to 10.07×10^6. The results indicated that the peak heating rate in the vicinity of the corner could be about 1.5 times the undisturbed flat-plate value outside the mutual boundary-layer interaction region. This high heating rate was attributed to the mutual interaction of the inviscid flow field with the boundary layer. Within the mutual boundary-layer interaction region a decrease in the heating rate was observed, and this result was in qualitative agreement with theoretical results. Author

N64-27518 Argonne National Lab., Ill.
HEAT AND MASS TRANSFER TO A GAS-FLUIDIZED BED OF SOLID PARTICLES
Edward N. Ziegler Dec. 1963 69 p refs
(Contract W-31-109-ENG-38)
(ANL-6807) OTS: $1.75

Three aspects of the mechanism of heat and mass transport from an exchange surface to a fluidized bed of solid particles are presented. The first part concerns an investigation of simultaneous heat and mass transfer from the surface of a

sphere for comparable situations in a gas stream and a gas-fluidized bed of solid particles; the results indicate that in any mechanism of heat transfer in the fluidized state, 80% to 95% of the transfer must be accounted for by particle transfer. The second part presents the results of measurements of heat-transfer coefficients from a porous sphere and a cylindrical heater to a bed of solids fluidized in an airstream. Finally, the mass-transfer data obtained in the first two studies are analyzed; a correlation based on dimensional analysis is found to accurately predict the Sherwood numbers for transfer from a stationary sphere to a fluidized bed of nonadsorbing particles; and a model is proposed to describe the more general case of a bed of adsorbing particles. M.P.G.

N64-27520 Wisconsin U., Madison Theoretical Chemistry Inst.
NOTE ON A PAPER BY SLIEPCEVICH AND FINN
Frank C. Andrews 15 Apr. 1964 10 p refs
(Grant NSF-G-20725)
(WIS-TCI-42; AD-600073)

A recent paper by Sliepcevich and Finn claims to derive the basic equations of irreversible thermodynamics, in particular, the reciprocal relations, from fundamental macroscopic principles. This paper is analyzed and shown to contain simply a truism. Author

N64-27575 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
MEASUREMENTS OF THE INTEGRATED INTENSITIES OF THE 5.3-μ FUNDAMENTAL AND 2.7-μ OVERTONE BANDS OF NO BETWEEN 1400° and 2400° K
J. C. Breeze, C. C. Ferriso, and J. L. Anderson Jun. 1964 34 p refs
(Contract Nonr-3902(00))
(GDA-DBE64-039; AD-443148)

Measurements were made of the total integrated band intensities of the 5.3μ fundamental and the 2.7μ overtone bands of NO in the temperature range 1,400° to 2,400° K. The NO gas sample was heated to the high temperature by a reflected shock-wave technique. Within the temperature range used in the present experiments, the integrated band intensity of the NO fundamental does not vary. However, the integrated intensity of the first overtone band of NO shows a small temperature dependence. The temperature dependencies of the two bands are in agreement with theoretical temperature dependencies determined assuming a harmonic oscillator approximation to the NO molecule. Using the theoretical temperature dependencies, the experimental data were extrapolated to give values of the integrated intensities at STP. The values of a^* obtained for the fundamental and first overtone bands are $76 \pm 7\ cm^{-2}\text{-}atm^{-1}$ and $2.8 \pm 0.5\ cm^{-2}\text{-}atm^{-1}$, respectively. Author

N64-27606 Little (Arthur D.) Inc., Cambridge, Mass.
RESEARCH ON THERMODYNAMICS OF THE Al-B-O AND Be-B-O SYSTEMS Quarterly Report, 1 Mar.–31 May 1964
Paul E. Blackburn [1964] 8 p refs
(Contract ARPA Order-315-62)
(QR-8; AD-442537)

Knudsen vapor studies on the Al-B-O system were continued. Pressure-composition curves at 1,054° and 1,156° C both dropped to very low B_2O_3 pressures near 82 mole % Al_2O_3. This composition corresponds to the previously reported mixed oxide $9Al_2O_3\text{-}2B_2O_3$. Increasing the temperature to 1,284° C for 2 hours failed to produce any further detectable weight loss. Author

N64-27607 Little (Arthur D.) Inc., Cambridge, Mass.
RESEARCH ON THERMODYNAMICS OF THE Al-B-O AND Be-B-O SYSTEMS Quarterly Report, 1 Jun.–1 Aug. 1963
Paul E. Blackburn [1963] 12 p refs
(ARPA Order 315-62)
(QR-5; AD-428106)

Pressure composition measurements were made on the $BeO\text{-}B_2O_3$ system at two temperatures. Using the $MgO\text{-}B_2O_3$ system as a model and literature evidence for $3BeO\text{-}B_2O_3$, a phase diagram was constructed for the Be-B-O system. The measurements and constitutional diagram agree in many respects, but additional information is needed to complete this study. Author

N64-27610 Michigan U., Ann Arbor College of Engineering
INVESTIGATION OF LIQUID METAL BOILING HEAT TRANSFER Fourth Quarterly Progress Report
Robert E. Barry, C. Phillip Colver, Herman Merte, Jr., Andrew Padilla, Jr., and Lowell R. Smith Feb. 1963 66 p refs
(Contract AF 33(616)-8277)
(Rept.-04526-14-P; AD-299262)

Virtually all phases of the project reached operational stages. The high flux nucleate pool boiler was subjected to preliminary checkout procedures during which water was pool boiled at fluxes from 20,000 to 500,000 Btu/hr sq ft. The results checked well with previous data from a 3/8-in. OD tube. Construction of the film boiler is essentially complete. The liquid metal loop was received; it will be housed in a new facility. Installation procedures are almost complete. The agravic studies were set back by a series of delays in the design and construction stages. Progress was made on the analytical studies of the film boiling process. Preliminary results from this study are discussed in this report, and calculated minimum fluxes for several alkali metals were tabulated. Author

N64-27624 Aerospace Corp., El Segundo, Calif. Electronics Div.
THE ANALYSIS OF THERMAL TECHNIQUES FOR SPACE-BORN MASS SENSING
M. Ritter 30 May 1964 21 p
(Contract AF 04(695)-269)
(TOR-269(4540-80)-1; AD-601627)

An analysis is given of the possibilities for the determination of the mass of a satellite from the measurement of its thermal behavior. Only dynamic thermal processes exhibit mass dependency. An isothermal satellite model that possesses greater mass discrimination capability than structurally complex satellites is analyzed. For this model, the uncertainties in the several parameters influencing the thermal behavior are inherently so large that only a feeble, inadequate mass discrimination capability results. It is concluded that thermal techniques are not promising for the determination of the mass of a satellite. Author

N64-27654 Argonne National Lab., Ill.
TWO-PHASE HEAT TRANSFER WITH GAS INJECTION THROUGH A POROUS BOUNDARY SURFACE
A. A. Kudirka Mar. 1964 122 p refs
(Contract W-31-109-ENG-38)
(ANL-6862) OTS: $2.50

Hydrodynamic aspects of two-phase heat transfer were studied experimentally in a forced-circulation system for the low-quality range. The role and influence of nucleation and convective mechanisms in enhancing heat transfer and the nature of the nucleation mechanism, including the influence of flow pattern, mass velocity, void fraction, and quality on the rate and nature of heat transfer, were investigated. G.D.B.

N64-27702 MSA Research Corp., Callery, Pa.
THERMOPHYSICAL AND TRANSPORT PROPERTIES OF LIQUID METALS First Quarterly Progress Report, Jan.–Mar. 1964
F. Tepper, A. Murchison, J. Zelenak, and F. Roehlich 14 Apr. 1964 20 p refs
(Contract AF 33(615)-1273)
(MSAR-64-36; AD-441064)

An equation of state was determined for superheated rubidium vapor. Work is continuing with cesium PVT. The electrical resistivity of liquid potassium and liquid NaK-78 was determined as follows: ρ potassium = $2.697778 + 1.40545 \times 10^{-2}T - 2.039807 \times 10^{-2}T^2 + 3.579247 \times 10^{-9}T^3$; and ρ NaK-78 = $12.81798 + 1.267917 \times 10^{-2}T - 3.650130 \times 10^{-7}T^2 + 2.851964 \times 10^{-9}T^3$, where T is in °F and ρ is in $\mu\Omega$ in. Thermal conductivities were derived for each metal. Mercury calibration data for the surface tension apparatus are reported. Vapor pressure determinations of NaK-78 are 90% completed.
Author

14 HUMAN BEHAVIOR

Includes crew training and evaluation; piloting; and psychological factors. *For simulators see*: 10 Facilities, Research and Support. *For related information see*: 16 Life Sciences.

N64-27057 Joint Publications Research Service, Washington, D.C.
CYBERNETICS AND THE DEVELOPMENT OF SCIENCES
E. A. Yakubaytis 4 Aug. 1964 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk Latv. SSR (Riga), no. 12, 1963 p 24–26
(JPRS-25714; TT-64-31986) OTS: $1.00

This article discusses the effects of the development of cybernetics and high-speed electronic machines on planning and management in the Soviet national economy. The history of mathematical logic as a science is reviewed, and the capabilities and applications of logic machines are generally described.
D.S.G.

N64-27066 Joint Publications Research Service, Washington, D.C.
ELEMENTS OF AUTOMATION IN MECHANICS OF INVESTIGATION OF HIGHER NERVOUS ACTIVITY
E. Frantik and M. Khorvat (Inst. of Labor Hyg. and Occupational Diseases, Prague) 12 Aug. 1964 9 p refs Transl. into ENGLISH from Zh. Vysshei Nervnoi Deyatel'nosti (Moscow), v. 14, no. 2, 1964 p 358–362
(JPRS-25861; TT-64-41132) OTS: $1.00

Conditions for using automatic devices and systems in the study of higher nervous activity, and the inherent advantages and disadvantages are discussed on the basis of experience.
D.E.W.

N64-27094 Kansas State U., Manhattan
THE EVOLUTION OF PERCEPTUAL FRAMES OF REFERENCE Technical Reports 17-20
William Bevan Apr. 1964 38 p refs
(Contract Nonr-3634(01))
(AD-600319)

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2. FORMS OF ORALLY-PRESENTED KNOWLEDGE OF RESULTS AND SERIAL REACTION TIME D. Hardesty and W. Bevan 7 p refs (See N64-27096 19-14)
3. VIGILANCE PERFORMANCE WITH A QUALITATIVE SHIFT IN REINFORCERS W. Bevan and E. D. Turner 8 p refs (See N64-27097 19-14)
4. TORQUE: A NEW DIMENSION IN TACTILE-KINESTHETIC SENSITIVITY B. Woodruff and H. Helson 8 p refs (See N64-27098 19-14)

N64-27095 Kansas State U., Manhattan
ANCHOR EFFECTIVENESS AS A FUNCTION OF STIMULUS VARIATION ON AN INCIDENTAL DIMENSION
Joan Faye Pritchard and William Beven *In its* The Evolution of Perceptual Frames of Reference Apr. 1964 9 p refs Submitted for Publication (See N64-27094 19-14)
(TR-17)

The study consisted of two experiments, A and B. Nine independent groups within each experiment judged a series consisting of a square and three rectangles as to their shape, the only dimension along which the series varied. A basic anchor group in each experiment, in addition, judged an anchor designate, which differed from its series members only in shape. Within each experiment the other seven anchor groups judged anchor designates identical in shape with the respective basic anchors but varying in size from the basic anchor. The sizes of these anchors were from one-half to four times the size of the basic anchor. A single control group served both experiments. Results for Experiment A indicated a U-shaped function for anchor potency as influenced by size of anchor. Maximum anchor effects were obtained in a region including the basic anchor and the one that was three times the size of the basic anchor. For Experiment B, in which the anchor shapes were selected to be more eccentric than those of A, the corresponding curve was complex. Maximal anchor effects were obtained with anchors 1/2 and 1 1/2 times the size of the basic anchor, the only one that failed to yield significant anchor effects.
Author

N64-27096 Kansas State U., Manhattan
FORMS OF ORALLY-PRESENTED KNOWLEDGE OF RESULTS AND SERIAL REACTION TIME
Don Hardesty and William Beven *In its* The Evolution of Perceptual Frames of Reference Apr. 1964 7 p refs Submitted for Publication (See N64-27094 19-14)
(TR-18)

The influence of differences in the form of orally presented knowledge of results upon serial reaction time to a visual signal was studied in four groups: a control group that received no knowledge of results, a group given actual reaction times in milliseconds, a group in which knowledge was provided through a monitor's comments of "very good" or "too slow," and a group receiving both types of reinforcement. The control group showed the usual decrement in performance over successive trials. All reinforcement groups displayed facilitated performance. While the group receiving quantitative information was not reliably superior to that receiving evaluative comment, the best performance was obtained in the group allowed both kinds of knowledge of results.
Author

N64-27097 Kansas State U., Manhattan
VIGILANCE PERFORMANCE WITH A QUALITATIVE SHIFT IN REINFORCERS
William Bevan and Edward D. Turner *In its* The Evolution of Perceptual Frames of Reference Apr. 1964 8 p refs Submitted for Publication (See N64-27094 19-14)
(TR-19)

The effect of shifting from positive to negative reinforcement, and the reverse, upon the detection of missing auditory signals was investigated. This experiment follows preliminary experiments with the serial learning of nonsense syllables, incidental memory for nonsense syllables, and visual monitoring. The present task was selected because it was of initial difficulty sufficient to allow for improvement in performance with reinforcement, and at the same time, yielded performance stable enough from trial to trial to allow for a competent estimate of the effect of temporal patterns of reinforcements. The subjects were 50 college students. Results are given for the performance on an auditory vigilance task, for the effect of reinforcement upon vigilance performance, and for performance under conditions of simple and changed reinforcement. R.T.K.

N64-27098 Kansas State U., Manhattan
TORQUE: A NEW DIMENSION IN TACTILE-KINESTHETIC SENSITIVITY
Burrton Woodruff and Harry Helson *In its* The Evolution of Perceptual Frames of Reference Apr. 1964 8 p refs Submitted for Publication (See N64-27094 19-14)
(TR-20)

Sensitivity to torque was measured by using a stimulus of constant weight that was manipulated to vary its torque according to its position on a rod. Five males were the subjects. Results of two experiments utilizing the method of constant stimulus differences and the comparative rating scale are reported. The Weber fraction for heavier judgments was found to be close to that reported for weight judgments, but that for lighter judgments was found to be considerably larger. Both the values of the adaptation levels and of the points of subjective equality indicated that negative time-order effect is operative in judgments of torque as well as in lifted weight judgments obtained by traditional methods. R.T.K.

N64-27351 Rocketdyne, Canoga Park, Calif.
SOURCES OF INFORMATION IN HUMAN FACTORS ENGINEERING
George A. Peters and Frank S. Hall 1 Jul. 1964 112 p refs
(RH-3398-E)

This is a compilation of various publications related to all aspects of human-factors engineering, both military and commercial. The bibliography is divided into reference sources, regulatory and guidance documents, descriptive publications, and illustrative reports. G.D.B.

N64-27385* Space Technology Labs., Inc., Redondo Beach, Calif.
STUDY OF MODEL MATCHING TECHNIQUES FOR THE DETERMINATION OF PARAMETERS IN HUMAN PILOT MODELS. REPORT ON TASK I LINEAR, TIME-INVARIANT MODELS
R. E. Humphrey, G. A. Bekey, R. E. Rose, and H. F. Meissinger [1963] 75 p refs
(Contract NAS1-2582)
(NASA-CR-56373; Rept.-8426-6002-RU-000) OTS: $7.60 ph

This report describes the results of an investigation of automatic computer techniques for determining the parameters of human pilot models in tasks where the pilot's performance can be described by a linear time-invariant model. Several model matching strategies including continuous and discontinuous, iterative schemes were developed, analyzed, and investigated experimentally, and their performance and computer implementation were evaluated. Relative merits of these different methods were explored, and guide lines for future study were established to determine preferred model matching approaches. The methods reported were applied successfully to the determination of human pilot parameters in a single axis compensatory tracking task. Results are compared with those previously reported in the literature. Satisfactory agreement of data obtained from the different model matching techniques was demonstrated. Author

N64-27433 Aerospace Research Labs., Wright-Patterson AFB, Ohio Behavioral Sciences Lab.
THE USE OF AUDITORY FEEDBACK IN SIMPLE REMOTE-HANDLING TASKS
William N. Kama, Louis T. Pope, and D. Frederick Baker May 1964 13 p ref
(AMRL-TDR-64-46; AD-603407)

A study was conducted to investigate the effect of auditory feedback upon performance of a remote handling task. Forty-five subjects, divided into three groups of 15 subjects each, used a Central Research Laboratory's model 8 master–slave manipulator to perform a simple remote handling task. One group performed the task under a no-sound condition; the second performed under a white-noise-only condition; the third group was provided with task-relevant auditory information. The results of this study suggest that, in the operation of this manipulator, supplementing visual, tactual, and proprioceptive information with task-relevant auditory information had little or no effect on performing simple remote handling tasks. Author

N64-27445 Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio
TIME HISTORY AS AN INFORMATION SOURCE FOR OPERATOR CONTROL OF ORBITAL RENDEZVOUS Technical Documentary Report, Jan.–Mar. 1964
William K. Mc Coy, Jr. (Ritchie and Associates, Inc.) and George G. Frost Jun. 1964 34 p refs Prepared Jointly with Ritchie and Associates, Inc.
(NASA Order W-11615-B; Contract AF 33(615)-1089)
(AMRL-TDR-64-55; AD-603597)

A study of operator performance in an orbital rendezvous task was conducted to evaluate a display of the orbit plane (X-Y plane) for rendezvous and to determine the effects of presenting a time history of the rendezvous as an aid to the operator. The system dynamics were simulated on an analog computer, and an X-Y plotter was used as the display system. Total ΔV expended and frequency and magnitude of control movements were used as performance indices. Range and range rate less than 10 ft (3.05 m) and 0.5 fps (0.15 m/sec), respectively, were used as criteria of successful rendezvous. Subjects were instructed to use the two-impulse orbital transfer technique. Subjects were able to rendezvous successfully both with and without the time history information, thus demonstrating that the orbit plane profile display was satisfactory. The addition of time history information resulted in significantly lower ΔV's than those obtained without the time history. Author

N64-27604 Army Cold Regions Research and Engineering Lab., Hanover, N.H.
OPERATOR VARIANCE IN THE DETERMINATION OF THE PLASTIC LIMIT
G. E. H. Ballard and W. F. Weeks Sep. 1963 13 p refs
(Contract DA-11-190-ENG-64)
(RR-117; AD-433188)

An experiment was designed to investigate operator variance in the determination of the plastic limit of cohesive soils, independent of sample preparation and hydration time. A standard sample was prepared by dry-mixing commercial clay, Grundite, with a pure silt. After the sample was hydrated for 3 weeks, five random samples were taken, and five replicates were performed on each sample. Analysis of variance (AOV) shows that there is no reason to doubt that the sample is homogeneous at the 0.05 level of significance. Random samples were then distributed to five zones of operators, where a zone is defined as a group of operators with similar backgrounds and engineering interests. Two operators from each group performed five replicates. The major factor contributing to the total sample variance is the inconsistency between the individual operators who, although able to duplicate their own determinations, do not call the same end point. Author

N64-27669 Joint Publications Research Service, Washington, D.C.
THE CONCEPT OF INFORMATION IN THE LIGHT OF LENIN'S THEORY OF REFLECTION
N. I. Zhukov 20 Aug. 1964 14 p Transl. into ENGLISH from Voprosy Filosofii (Moscow), No. 11, 1963 p 153–161
(JPRS-26012; TT-64-41282) OTS: $1.00

Cybernetics are philosophically discussed in terms of Communist theory. The Soviet terminology used in information and control theory, especially when related to writings of Party theoreticians, is highly specialized. G.D.B.

15 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gauges; sensors and transducers; and telescopes and cameras. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; and 22 Navigation and Guidance.

N64-26961* National Aeronautics and Space Administration, Washington, D.C.
PROCEEDINGS OF THE CENTRAL AEROLOGICAL OBSERVATORY, NO. 42
G. A. Kokin and N. S. Livshits, ed. Jul. 1964 194 p refs
Transl. into ENGLISH of the collection of articles "Trudy Tsentral'noy Aerologicheskoy Observatorii", No. 42 Moscow, Gidrometeorol. Izd., 1962
(NASA-TT-F-1411) OTS: $5.50

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3. THE OMEGATRON MASS SPECTROMETER A. F. Chizhov p 48–65 refs (See N64-26964 19-15)

4. SOME PROCESSES OCCURRING IN A MASS SPECTROMETER A. I. Repnev and A. F. Chizhov p 66–95 refs (See N64-26965 19-15)

5. CERTAIN PRELIMINARY RESULTS OF THE DEVELOPMENT OF A METHOD FOR THE QUANTITATIVE DETERMINATION OF THE COMPOSITION OF A GAS MIXTURE BY AN OMEGATRON MASS SPECTROMETER A. F. Chizhov p 96–107 refs (See N64-26966 19-15)

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7. THE USE OF THE ELECTRONIC SYSTEM OF THE FEU-34 PHOTO-MULTIPLIER AS AN AMPLIFIER OF WEAK ION CURRENTS A. V. Fedynskiy p 119–122 refs (See N64-26968 19-15)

8. A VACUUM SYSTEM FOR MASS-SPECTROMETRIC ANALYSES OF THE ATMOSPHERE O. K. Kostko and A. F. Fedynskiy p 123–131 refs (N64-26969 19-15)

9. DENSITY MEASUREMENTS BY A TIME-OF-FLIGHT METHOD Yu. A. Bragin p 132–142 refs (See N64-26970 19-15)

10. THE POSSIBILITY OF MEASURING THE MOBILITIES AND CONCENTRATION OF CHARGED PARTICLES IN THE ATMOSPHERE BY THE METHOD OF ELECTRICAL SHUTTERS Yu. A. Bragin p 143–151 refs (See N64-26971 19-15)

11. MEASUREMENTS OF GAS DENSITY BY DETERMINING THE PATH LENGTH OF LITHIUM IONS Yu. A. Bragin p 152–155 refs (See N64-26972 19-15)

12. ACCOMMODATION OF AIR ON TUNGSTEN FILAMENTS AND THE RADIATION COEFFICIENT OF TUNGSTEN N. V. Zagoruyko and G. A. Kokin p 156–175 refs (See N64-26973 19-15)

13. A TRANSISTOR SWITCHING CIRCUIT V. I. Kozlov p 176–191 refs (See N64-26974 19-09)

14. A MAGNETIC RECORDING SYSTEM FOR SLOWLY VARYING METEOROLOGICAL PARAMETERS N. K. Vinnichenko and G. N. Shur p 192–200 refs (See N64-26975 19-15)

N64-26963* National Aeronautics and Space Administration, Washington, D.C.
FLIGHT-TYPE MASS SPECTROMETERS
G. M. Martynkevich *In its* Proc. of the Central Aerological Obs., no. 42 Jul. 1964 p 22–47 refs (See N64-26961 19-15) OTS: $3.50

The paper considers, after a brief account of the development of flight-type mass analyzers, some of their specifications, the parameters of instruments used in rocket investigations, and some laboratory mass-spectrometers that appear promising for future use in rocket investigations. Author

N64-26964* National Aeronautics and Space Administration, Washington, D.C.
THE OMEGATRON MASS SPECTROMETER
A. F. Chizhov *In its* Proc. of the Central Aerological Obs., no. 42 Jul. 1964 p 48–65 refs (See N64-26961 19-15) OTS: $3.50

A brief outline of the theory of the omegatron mass spectrometer is given, and certain results of the development of a laboratory model of this instrument are presented. Author

N64-26965* National Aeronautics and Space Administration, Washington, D.C.
SOME PROCESSES OCCURRING IN A MASS SPECTROMETER
A. I. Repnev and A. F. Chizhov *In its* Proc. of the Central Aerological Obs., no. 42 Jul. 1964 p 66–95 refs (See N64-26961 19-15) OTS: $3.50

An attempt is made to evaluate some of the more important processes occurring in analyses of a gas mixture using a mass spectrometer. Selection effects in the gas flow in the instrument and in the pumping speed of individual constituents can considerably distort gas-composition measurements. The composition of gases in a high-vacuum system depends on the sorption properties of the surface of the instrument. These properties can be different for different gases. The composition of a gas can be affected by atom recombination on the surface of hot filaments and on the walls of the instrument. The results of analysis of gas composition in an instrument can be affected by disassociation due to electron impact, multiple ionization, and several other processes. P.V.E.

N64-26966* National Aeronautics and Space Administration, Washington, D.C.
CERTAIN PRELIMINARY RESULTS OF THE DEVELOPMENT OF A METHOD FOR THE QUANTITATIVE DETERMINATION OF THE COMPOSITION OF A GAS MIXTURE BY AN OMEGATRON MASS SPECTROMETER
A. F. Chizhov *In its* Proc. of the Central Aerological Obs., no. 42 Jul. 1964 p 96–107 refs (See N64-26961 19-15) OTS: $3.50

A graduated vacuum apparatus is described, and results of investigations of some of its parts are presented. Results are given of an experiment for selecting a material for the cathode of an omegatron mass spectrometer that does not affect measurements of the partial pressure of molecular nitrogen. Author

N64-26967* National Aeronautics and Space Administration, Washington, D.C.
A SWEEP OSCILLATOR
A. S. Ozerova *In its* Proc. of the Central Aerological Obs., no. 42 Jul. 1964 p 108–118 refs (See N64-26961 19-15) OTS: $3.50

A sweep oscillator of small dimensions for use in an omegatron mass spectrometer is described. The sweep oscillator generates an alternating electric field of constant amplitude, with a frequency that varies in the range 0.05 to 3.05 mc/s. The rate of variation of the frequency is determined by the time constant of an electrometer-tube amplifier that is larger than the time constant of the remaining stages in the circuit. P.V.E.

N64-26968* National Aeronautics and Space Administration, Washington, D.C.
THE USE OF THE ELECTRONIC SYSTEM OF THE FEU-34 PHOTO-MULTIPLIER AS AN AMPLIFIER OF WEAK ION CURRENTS
A. V. Fedynskiy *In its* Proc. of the Central Aerological Obs., no. 42 Jul. 1964 p 119–122 refs (See N64-26961 19-15) OTS: $3.50

It is shown that the electronic system of a photomultiplier can be used to amplify ion currents. The FEU-34 photomultiplier is a version of the electron multiplier that is small, lightweight, and uses little power. It has the electronic system of an ordinary photomultiplier with alloyed emitters of beryllium bronze (Cu Be) or aluminum–magnesium alloy (Al Mg), in which the secondary emission coefficient does not appreciably vary for systematic admissions of air into the system. Author

N64-26969* National Aeronautics and Space Administration, Washington, D.C.
A VACUUM SYSTEM FOR MASS-SPECTROMETRIC ANALYSES OF THE ATMOSPHERE
O. K. Kostko and A. V. Fedynskiy *In its* Proc. of the Central Aerological Obs., no. 42 Jul. 1964 p 123–131 refs (See N64-26961 19-15) OTS: $3.50

A difficulty that arises in measurements of atmospheric composition by mass-spectrometer instruments is the fact that instruments for composition analysis cease to give correct readings at pressures above a certain critical value and below a certain height. To measure composition at heights below the critical level, a vacuum system is suggested that enables the composition of the free atmosphere at gas pressures exceeding the critical pressure to be analyzed. Preliminary laboratory experiments showed that the selected system enables the height of applicability of mass-spectrometric methods to be reduced down to approximately 50 km. P.V.E.

N64-26970* National Aeronautics and Space Administration, Washington, D.C.
DENSITY MEASUREMENTS BY A TIME-OF-FLIGHT METHOD
Yu. A. Bragin *In its* Proc. of the Central Aerological Obs., no. 42 Jul. 1964 p 132–142 refs (See N64-26961 19-15) OTS: $3.50

A method is suggested for measuring the density of a gas in the pressure range 10- to 10^{-3}-mm Hg. Collision processes of ions with molecules can be investigated by this method. An instrument for density measurements in the pressure range 10- to 10^{-1}-mm Hg is described. Author

N64-26971* National Aeronautics and Space Administration, Washington, D.C.
THE POSSIBILITY OF MEASURING THE MOBILITIES AND CONCENTRATION OF CHARGED PARTICLES IN THE ATMOSPHERE BY THE METHOD OF ELECTRICAL SHUTTERS
Yu. A. Bragin *In its* Proc. of the Central Aerological Obs., no. 42 Jul. 1964 p 143–151 refs (See N64-26961 19-15) OTS: $3.50

A method and circuit for measuring the mobilities and concentrations of positive ions are described. In the form described here, the measurement circuit and method are suitable over a pressure range from approximately 50- to 10^{-2}-mm Hg. The results of laboratory tests of the instrument are presented. Author

N64-26972* National Aeronautics and Space Administration, Washington, D.C.
MEASUREMENTS OF GAS DENSITY BY DETERMINING THE PATH LENGTH OF LITHIUM IONS
Yu. A. Bragin *In its* Proc. of the Central Aerological Obs., no. 42 Jul. 1964 p 152–155 refs (See N64-26961 19-15) OTS: $3.50

The paper outlines a method of measuring air density at pressures from 10^{-1}- to 10^{-3}-mm Hg by determining the path length of lithium ions. Author

N64-26973* National Aeronautics and Space Administration, Washington, D.C.
ACCOMMODATION OF AIR ON TUNGSTEN FILAMENTS AND THE RADIATION COEFFICIENT OF TUNGSTEN
N. V. Zagoruyko and G. A. Kokin *In its* Proc. of the Central Aerological Obs., no. 42 Jul. 1964 p 156–175 refs (See N64-26961 19-15) OTS: $3.50

A hot filament method for determining the accommodation and radiation coefficients is described. Data are presented of the radiation and accommodation coefficients of tungsten in the 20° to 100° C temperature range. In instruments used for investigating elevated layers of the atmosphere, tungsten is widely employed in the construction of sensitive elements. Such a use of tungsten requires the stabilization of its properties by preliminary thermal treatment. In the process, however, the surface properties of tungsten are disturbed, which leads to modification of the radiation and accommodation coefficients; these coefficients occur in the formulas connecting the instrument readings with the parameters of the atmosphere. A justification for the investigation described here is the fact that data on the radiation coefficients are only available for nonoxide-coated tungsten, while data on the accommodation coefficient of air on tungsten are apparently not available. Author

N64-26974* National Aeronautics and Space Administration, Washington, D.C.
A TRANSISTOR SWITCHING CIRCUIT
V. I. Kozlov *In its* Proc. of the Central Aerological Obs., no. 42 Jul. 1964 p 176–191 (See N64-26961 19-15) OTS: $3.50

The theory and a description of a switching circuit using semiconductor devices is presented. The switch is based on the principle that the output resistance of a transistor depends on the concentration of minority carriers in the base, which depends, in turn, on the voltage across the emitter-base junction. Laboratory tests of a prototype of the described switch are discussed. P.V.E.

N64-26975* National Aeronautics and Space Administration, Washington, D.C.
A MAGNETIC RECORDING SYSTEM FOR SLOWLY VARYING METEOROLOGICAL PARAMETERS
N. K. Vinnichenko and G. N. Shur *In its* Proc. of the Central Aerological Obs., no. 42 Jul. 1964 p 192–200 refs (See N64-26961 19-15) OTS: $3.50

A method for the magnetic recording of the results of meteorological measurements that enables statistical processing to be automated is described. The encoding and decoding systems are also described. Author

N64-26996 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PROBE CHARACTERISTICS OBTAINABLE USING DIFFERENT PROBE TYPES IN THE PLASMA OF A GAS DISCHARGE IN MERCURY AND CESIUM VAPORS
N. I. Ionov and A. Ya. Tontegode *In its* J. of Tech. Phys. 3 Jun. 1964 p 1–12 refs (See N64-26995 19-23)

A comparative study of the probe characteristics of electron and ion currents in one-electrode (cylindrical and flat), two-, three-, and four-electrode flat probes was carried out. The conclusion was reached that the fullest and most correct information about the distribution of electrons and ions in a plasma can be obtained with the help of three- and four-electrode probes. Electron and ion temperature measurements were made in a cesium and mercury gas-discharge plasma of low pressure. Author

N64-27038 Sandia Corp., Albuquerque, N. Mex.
REENTRY FLIGHT DEMONSTRATION NUMBER TWO (RFD-2): SPECTROGRAPHS, PHOTOMETERS, AND EVENT CAMERAS DEVELOPED FOR SNAP REENTRY STUDIES
Dan Parsons Aug. 1964 24 p
(SC-RR-64-968) OTS: $0.75

Spectrographs, photometers, and event cameras were developed for use in attempting to record the disassembly of an inert nuclear power supply and the complete ablation of inert fuel rods during an actual reentry operation, RFD-2, to be conducted off the island of Bermuda. Author

N64-27047 United Kingdom Atomic Energy Authority, Harwell (Gt. Brit.) Atomic Energy Research Establishment
THE ULTRA-SOUND CAMERA. PART I: THE INSTRUMENT CONSTRUCTED AT A.E.R.E.
J. F. Sayers Nov. 1963 36 p refs
(AERE-R-4356)

The construction of a laboratory prototype instrument for examining materials using ultrahigh-frequency sound is described. The instrument employs an ultrasound image converter tube that is the acoustic equivalent of a television camera tube. Author

N64-27056 Joint Publications Research Service, Washington, D.C.
SEISMOGRAPHIC PROSPECTING EQUIPMENT
V. P. Nomokonov, G. A. Grechishnikov, A. N. Kuznetsov, S. N. Kasparova, and L. A. Yurkova 3 Aug. 1964 15 p refs Transl. into ENGLISH of 3 Articles from Razved. i Promysl. Geofiz. (Moscow), no. 48, 1963 p 45–47, 63–65, 87–91
(JPRS-25704; TT-64-31976) OTS: $1.00

This paper is discussed in three parts: (1) Use of the SS-24P mass-produced set in the recording of high frequency at various seismic stations; a diagram is presented of the circuitry and of the switching mechanisms and the rewiring of the SS-24P amplifier. (2) An error analysis of the K-parameter value in the telluric currents (TC) method, used for studying the relief of high-resistance reference electrical level; probability distribution curves are plotted showing the random values of errors involved in finding the K-parameter. (3) More effective application of seismic and other geophysical equipment as shown from data compiled at eight seismic stations. A.L.B.

N64-27060 Joint Publications Research Service, Washington, D.C.
DOUBLE RESECTION IN SPACE
V. V. Pogorelov 7 Aug. 1964 13 p refs Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), no. 6, 1964 p 40–46
(JPRS-25780; TT-64-41051) OTS: $1.00

A method is proposed for determining the elements of the exterior orientation of two overlapping air photos by reference points distributed over the areas of both photographs. With a 60% fore-and-aft overlap, this area amounts to 140% of the area of the aerial photograph and is 2.3 times larger than the area in which the reference points are distributed for orientation of a single net. The accuracy of this proposed method for determining elements of the exterior orientation by four reference points is characterized by weighting factors for the same conditions for aerial photography. The weighting factors are given in the third line of the table. The data in the table show that in this case, the angular elements of exterior orientation turn out to be more accurate. Author

N64-27078 Air Force Cambridge Research Labs., Bedford, Mass.
FEASIBILITY OF A LUNAR OPTICAL RANGING EXPERIMENT
Robert L. Iliff and Michael S. Tavenner Dec. 1963 24 p refs (AFCRL-63-908; AD-434586)

A lunar ranging experiment using a high-energy pulsed laser is discussed; special attention is given to the required minimum return signal, interfering radiation, detector devices, and pulse length. Author

N64-27088 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ELECTRICAL RESISTANCE MEASURING DEVICES
Zdenek Ruzga 20 Mar. 1964 416 p refs Transl. into ENGLISH of the book "Elektricheskiye Tenzometry Soprotivleniya" Moscow, Gos. Energ. Izd., 1961 p 1–336
(FTD-TT-63-730/1+2; AD-600776)

This work discusses the nature and properties of electric–wire–resistance strain gages. It includes a general review of various types of strain gages in order to assess relative advantages of measuring methods and instruments. The fundamental properties of wire resistance strain gages, their construction and instrumentation, the accuracy of the measurement methods, and detailed descriptions of their applications are presented. D.S.G.

N64-27089 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ACTA ASTRONOMICA SINICA (SELECTED ARTICLES)
3 Jun. 1964 23 p refs Transl. into ENGLISH of 2 articles from Tien Wen Hsueh Pao (Guozi Shudian), v. 10, no. 1, Jun. 1962 p 24–33
(FTD-TT-64-170/1+2+3+4; AD-442437)

CONTENTS:

1. TEST RESULTS OBTAINED WITH A 60-CM PARABOLIC MIRROR Y. Shih-Ching and L. Te-P'ei p 1–10 refs (See N64-27090 19-15)

2. THE PROBLEM OF SELECTING MIRROR MATERIAL AND THE POSSIBILITY OF USING CERAMICS FOR MIRRORS Y. Shih-Ching p 11–19 refs (See N64-27091 19-17)

N64-27090 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
TEST RESULTS OBTAINED WITH A 60-cm PARABOLIC MIRROR
Yang Shih-Ching and Li Te-P'ei (Tze-Ching-Shan Obs., Chinese Acad.) *In its* Acta Astron. Sinica (Selected Articles) 3 Jun. 1964 p 1–10 refs (See N64-27089 19-15)

The test methods used in repolishing the 600-mm parabolic mirror for the telescope built at Nanking in 1958 are described. The compensation shadow method proposed by D.D. Maksutov was used as a working method, and quantitative examinations were made by a visual method using an ocular and the Hartmann photographic procedure. A photograph of the compensation setup shadow pattern is presented. The results of quantitative tests are also given. Author

N64-27092* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
RADIOMETER-PYROMETER FOR ANALYSIS OF GASEOUS COMBUSTION PRODUCTS
Donald R. Buchele Washington, NASA, Aug. 1964 22 p refs (NASA-TN-D-2405) OTS: $0.50

A radiometer–pyrometer was developed for the measurement of absorption, emission, and temperature of gases. Spectral selection was by filters over a wavelength range limited by fused-quartz optics with a choice of three detectors. Radiation of an external source and an internal source was intercompared by chopping at 120 cps. Absolute radiation from the hydroxyl group (OH) and water in the combustion products of natural gas and gasoline was measured. Author

N64-27120* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF PENETROMETERS TO THE STUDY OF PHYSICAL PROPERTIES OF LUNAR AND PLANETARY SURFACES
John Locke Mc Carty, Alfred G. Beswick, and George W. Brooks Washington, NASA, Aug. 1964 30 p refs
(NASA-TN-D-2413) OTS: $0.75

A study was made to evaluate the practicality of employing the penetrometer technique as a means for determining physical characteristics of a remote surface such as that of the moon or a planet. The study included a review of the history and fundamentals of the penetrometer concept and an examination of the basic requirements for penetrometers and necessary support apparatus. The applicability of penetrometer concepts and techniques to various present-day manned and unmanned spacecraft is discussed. In addition, details of a specific application of the concept as a payload for the Ranger spacecraft are appended. Author

N64-27203* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
SOME OPTICAL TECHNIQUES FOR TEMPERATURE AND CONCENTRATION MEASUREMENTS OF COMBUSTION IN SUPERSONIC STREAMS
Erwin A. Lezberg and Donald R. Buchele Washington, NASA Aug. 1964 24 p refs
(NASA-TN-D-2441) OTS: $0.75

Three optical techniques are discussed for determining temperature and species concentration in supersonic streams of combustion products. The three techniques are line-reversal pyrometry, determination of the hydroxyl concentration by spectral line absorption, and determination of carbon dioxide and water concentration by infrared spectral absorptance. The line-reversal technique that uses a locally injected emitter and the hydroxyl radical-absorption technique are illustrated by measurements in a supersonic nozzle. The determination of the infrared emitting species has had some limited demonstration in a shock tube. The limitations of these techniques for measurements in exhaust nozzles and supersonic combustion experiments are examined with reference to temperature, optical depth, and response time. Author

N64-27206 Observatorium Bosscha, Bandung (Indonesia)
THE PHOTOELECTRIC INSTRUMENT AT THE BOSSCHA OBSERVATORY
Santoso Nitisastro [1963] 15 p refs Repr. from Proc. of the Bandung Inst. of Tech., V. 2, No. 4, 1963 *Its* Contributions No. 22

A description of the photoelectric photometer at the Bosscha Observatory Lembang, operated with a photomultiplier of type 1P21 refrigerated with dry ice or using an EMI-type of multiplier (nonrefrigerated) is presented below. The photometer, provided with U, B, V, and R filters and attached to the 37-cm Bamberg–Schmidt refractor, was used for determining the atmospheric extinction at the Observatory during the last part of the dry season in 1962. Author

N64-27218 Michigan U., Ann Arbor Acoustics and Seismics Lab.
THE REQUIREMENTS OF A HIGH-SENSITIVITY SEISMOGRAPH STATION VESIAC State-Of-The-Art Report
Dean S. Carder Oct. 1963 97 p refs
(Contract ARPA-SD-78)
(Rept.-4410-63-X)

The efficiency of a short-period seismograph is regulated largely by the nature and magnitude of the so-called background noise prevalent at the station. This report discusses possible sources and methods of propagation of background noise and the selection of optimum sites and methods for reducing the effect of noise. Present and suggested future arrays are included in this discussion. Highly sensitive seismograph stations and instruments in current operation are described, and comparisons are made of the ability of some of the better stations to record magnitude 4 to 5.5 earthquakes. Suggested designs of unmanned and other special-purpose seismic stations are included. Author

N64-27256* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
PILE-OF-PLATES POLARIZER FOR THE VACUUM ULTRAVIOLET
William C. Walker
(NASA-TM-X-55022; X-613-64-87) OTS: $1.10 ph

A pile-of-plates polarizer and analyzer for the spectral region 1,200 to 1,600 A have been constructed from cleaved LiF plates 13 mm in diameter and 0.3 to 0.8 mm thick. Both polarizer and analyzer consist of identical cylinders with 3/16-in. apertures and contain eight 1-mm solts cut at an angle of 60° to the axis of the cylinder. The slots are arranged in two opposing groups of four each to give an on-axis emergent beam. Measurements with a six-plate polarizer gave polarizations of 82% and 65% at 1,200 and 1,600 A, respectively. The effective transmission of the polarizer was 4.3% and 21.5% at these two wavelengths. Performance characteristics of the polarizer are presented and discussed. Author

N64-27268* Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div.
SATURN LONG RANGE AZIMUTH ALIGNMENT THEODOLITE (LR2A)
W. Kokoi and W. Zukowsky 6 May 1963 78 p
(Contract NAS8-2555)
(NASA-CR-58047; ER-7030B) OTS: $7.60 ph

The Saturn LR2A theodolite constitutes an excellent solution to the azimuth laying problem of large space boosters. Operating at distances up to 1,000 ft, it provides extreme angle sensing accuracy in the presence of up to ±12 in. of dynamic and static booster sway, and any amount of sag during fueling. In its present configuration it permits fully remote operation by operator reference to two TV camera displays. A new LR2A/GS version currently under development incorporates alignment capability for a second prism and, by the addition of automatic sway tracking, operates essentially unattended. In either case the LR2A instrumentation is quite simple and basic, consisting primarily of static elements, and possesses excellent reliability (computed). Its extremely flexible design permits easy adaptation to a wide variety of alignment assignments. Author

N64-27271* Southwest Center for Advanced Studies, Dallas, Tex.
A RADIO FREQUENCY PROBE FOR ELECTRON DENSITY MEASUREMENTS
Walter J. Heikkila [1963] 21 p refs Presented at the Conf. on Direct Aeronomic Measurements in the Lower Ionosphere, Illinois U., Urbana, 21–23 Oct. 1963
(Grant NsG-269-62)
(NASA-CR-56725) OTS: $2.60 ph

An RF probe for electron-density measurements in the D- and E-regions of the ionosphere has been developed and used successfully on two rocket flights. Through the use of two slightly differing frequencies, it is possible to estimate the electron collision frequency as well as the electron density. With a choice of 3 mc/s and 12 mc/s, the collision frequency can be measured accurately in the D-region between 50 and 80 kms. If high accuracy in the frequency-shift measurements is preserved in the telemetry, then the low collision frequencies of the E-region at 100 km are detectable. D.S.G.

N64-27312* Massachusetts Inst. of Tech., Cambridge Experimental Astronomy Lab.
TOWARDS A LOW LEVEL ACCELEROMETER
Shaoul Ezekiel (M.S. Thesis) Jun. 1964 104 p refs
(Grant NsG-254-62; Contract DSR-5007)
(NASA-CR-56941; TE-11) OTS: $9.10 ph

A preliminary investigation was made into a low-level accelerometer incorporating a diamagnetically supported magnet inside a superconducting tube. Low-level control forces were examined, and the magnetic force was found most suitable. Light pressure exerts a measureable force and is suggested for calibration. The feasibility of closing a feedback loop around the magnet was demonstrated. The accelerometer showed much promise for application below 10^{-6}g and the performance results obtained so far are limited only by displacement detector sensitivity and noisy environment. Author

N64-27350 Autonetics, Anaheim, Calif. Inertial Navigation Div.
A MICROMINIATURIZED PORTABLE BASE LINE ORIENTOR
D. D. Robinson and S. A. White 1 Aug 1963 68 p Submitted for Publication
(PUB-552-A-32)

This paper is a description of the Miniature Autonetics Base Line Equipment (MABLE), a portable, self-contained, back-pack base line orientor that employs state-of-the-art microminiaturization techniques in the electronics. The design requirements of finding the direction of true north within 1 minute of arc at latitudes up to 60°, within 20 minutes of time, are met by utilization of a single-axis floated gyro mounted in a unique flexure bearing, which isolates the gyro from rotational disturbances, and by microminiature circuitry of very advanced design, which provides highly sensitive readout with excellent noise rejection. A theodolite mounted to the gyro provides an optical means of providing a target bearing relative to true north. Author

N64-27378* General Mills, Inc., Minneapolis, Minn. Electronics Group
LUNAR TV CAMERA MANIPULATOR Final Report
F. Grimm and R. Sullivan [1961] 166 p refs Prepared for JPL
(Contracts NAS7-100; JPL-N-29999)
(NASA-CR-56790) OTS: $12.00 ph

The lunar television-camera manipulator is discussed in terms of the lunar environment, general design philosophy, manipulator description, specifications and component procurement, test data, gear analysis, and thermal analysis. The

boom elevation drive assembly is considered as especially well designed, since meticulous care was exercised to eliminate and reduce friction and to support loaded components in the best way. The temperature-control schemes are unique. G.D.B.

N64-27388* Research Triangle Inst., Durham, N.C. Solid State Lab.
THEORETICAL ANALYSIS OF OPERATIONAL CHARACTERISTICS OF MICROMETEOROID CAPACITOR DETECTOR, SEPTEMBER 1963–MARCH 1964
Apr. 1964 80 refs
(Contract NAS1-3343)
(NASA-CR-56316)

The study of the signal generation mechanism occurring upon impact of a projectile on a capacitor-type micrometeoroid detector was carried out by formulating a model for the impact process and then using this model to suggest possible mechanisms of capacitor discharge. In the assumed model, essentially one-dimensional strong shock wave theory was used to predict the impact induced thermodynamic states. These thermodynamic conditions were sufficient to produce a highly ionized plasma in the shocked regions of the capacitor and projectile. This plasma acts like a fluid metal, being bound together by free electrons in a lattice of positive ions. A quasi-lattice model of this type not only accounts for the formation of the plasma at temperatures much below those normally required for thermal ionization, but also accounts for the impact light flash. Author

N64-27397* Rutgers U., Newark, N.J.
A FEASIBILITY STUDY OF A RADIATION ANALYZER FOR THE ZODIACAL LIGHT Progress Report, 1 Sep. 1963–29 Feb. 1964
Auguste L. Rudy and Lawrence H. Aller Mar. 1964 104 p
(Grant NsG-550)
(NASA-CR-56313) OTS: $9.10 ph

The following are discussed: "The Scanning of the Zodiacal Light from an OSO (Orbiting Solar Observatory) Vehicle"; "Values for Brightness and Polarization of the Zodiacal Light"; "Particular Case for Data Analysis; the Gaussian Aspect with Respect to the Plane of Symmetry"; "Attenuation of the Noise Caused by Stars Crossing the Field of View"; "Angular Precision versus Angle of Field of View"; "Brightness versus Flux of Energy"; "Light-Transducer Requirements"; "The Difference to the Sum Ratio and the Measurement of the Degree of Polarization"; "Solar Spectral Irradiance and Light-Transducer Performance versus Brightness of the Zodiacal Light"; and "Basic Instrumentation for Studying the Zodiacal Light." R.T.K.

N64-27435 Kiruna Geophysical Observatory (Sweden)
A SYSTEM FOR AUTOMATIC COLLECTION OF GEOMAGNETIC DATA IN DIGITAL FORM Annual Summary Report, 1 Dec. 1962–31 Jan. 1964
G. Gustafsson, F. Eleman (Roy. Board of Shipping and Navigation, Stockholm), and K.-E. Heikkila 24 Mar. 1964 20 p refs
(Contract AF 61(052)-237)
(AFCRL-64-470; AD-603727) OTS: $1.00

An equipment has been constructed for automatic collection of geomagnetic data in digital form. It samples all three components of the earth's magnetic field each 30 seconds. The instrumentation has been tested for recording of one component during a year and found to be working satisfactory and is now being tested for three components. Author

N64-27457 Sylvania Electric Products, Inc., Mountain View, Calif. Sylvania Electronic Systems
OPTIMIZED COHERENT OPTICAL RECEIVER TECHNIQUES
Mahlon B. Fisher Griffiss AFB, N.Y., RADC, Jul. 1964 28 p
(Contract AF 30(602)-3162)
(RADC-TDR-64-221; AD-603278)

This report covers an applied research program to develop a scannable photosensitive image detector capable of responding to modulation at a microwave rate. The d.c. focusing tests were completed, and the detector now operates satisfactorily in a stack of permanent magnets rather than the large solenoid previously used. The direct modulation–demodulation experiment is now working very well with a modulation frequency of 10.7 gc. Operation has been demonstrated in both a nonscanning mode and in a scanning mode with a microwave output signal level of −90 dbm. The continued work on the semitransparent photosurface resulted in a photosurface not as susceptible to film breakup during the bakeout phase of tube processing as those previously reported. This improvement is primarily the result of the use of a very thin film of tungsten deposited under the photoelectric surface. This change in processing has been evaluated by means of several photodiodes. Author

N64-27510 Sociedade de Estudos e Projetos Aeronauticos, Sao Paulo (Brazil)
CONSIDERATIONS ON INFRARED TECHNOLOGY [CONSIDERACOES SOBRE A TECNOLOGIA DO INFRA-VERMELHO]
Apr. 1964 8 p In PORTUGUESE
(M-004/64)

This is a Brazilian nontechnical review of infrared technology—its history, development, and applications. G.D.B.

N64-27511 Norwegian Defence Research Establishment, Kjeller
AN ELECTROSTATIC RADIATION DETECTOR AND SOME POSSIBLE APPLICATIONS
K. Sand May 1964 24 p refs
(FFIF-F-452)

A short description is given of a radiation detection unit based on the use of an electrostatic relay in conjunction with an ionization chamber. Supplementary equipment necessary to complete a network for monitoring radioactive fallout is outlined. Some other possible applications are suggested and briefly discussed. Author

N64-27533 Canadian Armament Research and Development Establishment, Valcartier
ENERGY AND WAVELENGTH CALIBRATION OF A BALLOON BORNE SPECTROMETER FOR INFRARED BACKGROUND MEASUREMENTS (GONDOLA V)
J. A. Tardif Feb. 1964 24 p refs
(CARDE-TN-1591/64; AD-441246)

The spectral radiance response at simulated altitudes of 40,000 and 93,000 ft was obtained for the Gondola V grating spectrometer equipped with a gold-doped germanium detector. A wavelength calibration was also made for wavelengths between 3.4μ and 8.5μ. Author

N64-27622 Naval Postgraduate School, Monterey, Calif.
ENVIRONMENTAL ERRORS IN USE OF THE AIRBORNE INFRARED RADIATION THERMOMETER TO MEASURE SEA-SURFACE TEMPERATURE
Robert W. S. Christenson [1964] 33 p refs
(AD-601473)

An airborne infrared radiation thermometer (IRT) used to measure the sea-surface temperature is described, and the basic radiation principles on which the operation of the instrument depends are discussed. The environmental factors that may tend to introduce errors into the measurement of sea-surface temperature by the IRT are investigated first by reviewing the works of some other authors and secondly by empirical means using field data. The empirical results indicate that absorption and emission of infrared energy by atmospheric water vapor are the important physical phenomena that cause IRT errors. The results suggest that with increasing values of the combination of sea level mixing ratio and air temperature, IRT error decreases. An attempt is made to explain these results on the basis of radiation principles previously described. Author

N64-27650 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ANGULAR VELOCITY AND ACCELERATION PICK-UP
V. I. Parmenov 26 May 1964 4 p Transl. into ENGLISH of Russian Patent no. 154042, 2 Jun. 1962 p 1–2
(FTD-TT-64-238/1+2+4; AD-601563)

The known angular velocity and acceleration pickups, composed of two gyroscopes whose housings are connected to the body of the instrument by springs and are damped, have a relatively low level of sensitivity. In the proposed pickup, increased sensitivity is accomplished by using an inductance pickup and a tachometer generator whose rotors are coaxial and connected to the housing of one of the gyroscopes, and their stators are also connected to each other and to the housing of the other gyroscopes. A diagram shows the basic diagram of an angular velocity and acceleration pickup. Author

N64-27694 Itek Corp., Lexington, Mass.
STUDY OF IMAGE-EVALUATION TECHNIQUES Interim Engineering Report No. 6, 15 Dec. 1963–15 Apr. 1964
G. C. Brock, R. L. Dussault, R. G. Scully, and R. R. Shannon [1964] 57 p refs
(Contract AF 33(657)-9158)
(ITEK-9048-7; AD-600950)

The program of physical measurement and computer calculation in the development of a mathematical model is presented. Emphasis is placed on the calculation of lens performance from design data, development of a mathematical model for the film, and the calculation of images given by a system when the transfer functions for all its components are known. Experiments in simulated aerial photography are described, and an attempt is made to correlate psychophysical quality with physical parameters. The progress made in the measurement of lens transfer functions is described. Author

N64-27772 Ohio State U. Research Foundation, Columbus Antenna Lab.
AN ISOTROPIC PLASMA SLIDE RULE
R. J. Plugge 15 May 1964 11 p refs
(Contract AF 33(657)-10426)
(Rept.-1565-10; AD-441928)

A linear slide rule is presented with which the complex relative permittivity components of an isotropic plasma can be computed from the normalized plasma frequency and electron collision frequency, or vice versa. The reverse side has also been labeled so that these normalized parameters can be found from the electron number density, the electron collision frequency, and the EM wave frequency. Author

N64-27786 Itek Corp., Lexington, Mass.
STUDY OF IMAGE-EVALUATION TECHNIQUES Interim Engineering Report No. 8, 15 Apr.–15 Jul. 1964
W. L. Attaya, R. Barakat, R. R. Shannon, and P. Nisenson [1964] 52 p refs
(Contract AF 33(657)-9158)
(ITEK-9048-9; AD-602853)

The following are discussed: (1) the Foucault photometer method for ray-intercept measurements; (2) the image of an edge in the presence of off-axis aberrations; (3) experimental determination of lens–film transfer function; (4) a mathematical model for two steps of the photographic process—latent image formation and development; (5) transfer functions for wide-spectrum imagery; and (6) development-uniformity tests. R.T.K.

N64-27791 Itek Corp., Lexington, Mass.
STUDY OF IMAGE-EVALUATION TECHNIQUES Interim Engineering Report No. 7, 15 Dec. 1963–15 Apr. 1964
G. C. Brock, R. Barakat, E. B. Kitrosser, R. L. Dussault, W. L. Attaya et al [1964] 95 p refs
(Contract AF 33(657)-9158)
(ITEK-9048-8; AD-602625)

The following are discussed: the image of an edge in the presence of spherical aberration and defocusing; a simplified graphical method for the determination of single-bar response from symmetrical edge spread functions; measurement of lens–film transfer functions using sinusoidal targets and edge targets; mathematical basis for an edge transform program; and emulsion transfer functions—the coherent light method. R.T.K.

N64-27802* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SPACE AND THE MOON—PHOTOGRAPHY'S CHALLENGE FOR TOMORROW
John M. Eggleston and John R. Brinkman [1964] 37 p To be Presented at The Soc. of Photographic Instrumentation Engr., 9th Ann. Tech. Symp., Miami Beach, Fla., 25 Aug. 1964
(NASA-TM-X-51878) OTS: $3.60 ph

This paper describes some of the research in developing usable cameras for lunar photography, and some of the requirements for the future, particularly in hand-held lunar-surface cameras. There will probably be four cameras involved in the Apollo missions—a still camera (hand held); a time-sequence (motion picture) camera; a television camera; and a large format, high-resolution camera to be used in the command module. Some of the environmental problems that these cameras must be able to operate under include no heat convection, exposure to cosmic rays, no atmosphere, and no diffusion of light. The film and onboard processing are also items of great importance in the development of worthwhile lunar photography. A.W.

N64-27804* Nuclear Metals, Inc., Concord, Mass.
SPHERICAL ROTORS FOR CRYOGENIC GYROSCOPES Final Report
W. B. Nowak, W. P. Munro, and D. F. Kaufman 15 Mar. 1962 39 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950032)
(NASA-CR-58053; NMI-4980) OTS: $3.60 ph

The development and fabrication of special rotors for cryogenic gyroscopes was undertaken. Lucalox (alumina) and Homosil (fused quartz) spheres 4 cm in diameter were used as

rotor substrates. The spheres were coated with niobium vapor-deposited from $NbCl_5$ using hydrogen as a carrier gas. The spherical substrate was simultaneously suspended, rotated, and heated to about 1,000° C in a hot-gas bearing; the gas was argon issuing from a plasma torch. Bright, metallic coatings several tenths of a micron thick were produced on an equatorial band around the spheres. The coatings were very adherent, even after thermal cycling, and had a low electrical resistance at 300° K. The best coating, on a Lucalox substrate, was at least partially superconducting. A photoresist–anodization technique was demonstrated for accurately placing marks on the niobium for optical readout. Author

N64-27832* Grumman Aircraft Engineering Corp., Bethpage, N.Y.
SHOTPUT III DATA, GRUMMAN NORTHEAST TRACKING RANGE Final Report
H. C. Courten May 1960 12 p
(Contract NAS1-584)
(NASA-CR-56950; PGR-C-11)

This report consists of reduced time, event, and position data derived from photographs taken by cameras during the experiment designated Shotput 3. The following major areas were analyzed: trajectory of the 100-foot sphere; sequence of events measured against absolute time; and dispersion of second-stage smoke trail. The 100-foot sphere was first observed at 18 hours 23 minutes 50 seconds and took 2 seconds to reach apparent maximum volume. Halation around the balloon began 1 second after first sighting, indicating that high volume leakage commenced at that time. No particles were sighted near the balloon. Scintillation was not observed. The balloon was lost in earth shadow at 18 hours 30 minutes 45 seconds EST. R.T.K.

N64-27837 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE LOCAL METHOD FOR DIRECT MEASUREMENT OF THE BOUNDARY-LAYER VELOCITY PROFILE OF A NON-UNIFORMLY HEATED FLAT PLATE
Z. F. Slezenko 27 Apr. 1964 12 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 5, no. 10, 1962 p 47–52
(FTD-TT-63-1053/1+2+4; AD-600809) OTS: $0.50

In this article are examined the theoretical principles of a measuring method, an equation for sensitivity of the measuring device, a method of calculating velocity from a nomogram, the fundamentals of a local method for direct measuring of a velocity profile, and the principles of operating the experimental device. Author

N64-27839 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
GEODIMETER SVV-1 AND THE RESULTS OF ITS PROVING TESTS
V. A. Velichko 28 Apr. 1964 34 p Transl. into ENGLISH from Izvest. Vyssh. Ucheb. Zaved., Geod. i Aerofotos. (Moscow), No. 2, 1957 p 37–54
(FTD-TT-63-1154/1+2+4; AD-600786) OTS: $1.00

A description of the SVV-1 geodimeter, an optical radar distance-measuring device, and of its performance in surveying various test areas of the U.S.S.R. is presented. The observations were carried out using both the scintillation and the extremes methods, the choice of method depending upon the quality of the images. Error analyses show the scintillation method doubles the accuracy of the results. The performance of the device in first- through fourth-order triangulation work and its usefulness in establishing geodesic reference nets are discussed. M.P.G.

16 LIFE SCIENCES

Includes biology; exobiology; physiology; medicine; life support systems; radiation effects on biological systems; and space sickness. *For related information see*: 14 Human Behavior; and 28 Space Radiation.

N64-27036* National Aeronautics and Space Administration, Washington, D.C.
EFFECT OF CORTISONE ON THE METABOLISM OF RIBONUCLEIC ACID AND ITS NUCLEOTIDES IN LIVER DEVELOPMENT (VPLIV KORTIZONU NA OBMIN RNK TA YY NUKLEYOTIDIV U PECHINTSI V ONTOGENEZE)
Ts. M. Shereshevskaya Aug. 1964 18 p refs Transl. into ENGLISH from Ukr. Biokhim. Zh. (Kiev), v. 35, no. 5, 1963 p 656–667
(NASA-TT-F-224) OTS: $0.50

This investigation is concerned with the effect of cortisone on the content, qualitative composition, and metabolic rate of ribonucleic acid (RNA) and its individual nucleotides in the intact tissue and cell cytoplasm of the liver of white rats of different ages. Author

N64-27055 Joint Publications Research Service, Washington, D.C.
STUDIES IN RADIO-PROTECTIVE ACTION OF GASES
V. P. Paribok, G. F. Krupnova, and V. S. Kal'niy 3 Aug. 1964 21 p refs Transl. into ENGLISH of 2 articles from Tsitologiya (Leningrad), v. 6, no. 2, 1964 p 162–167, 222–225
(JPRS-25703; TT-64-31975) OTS: $1.00

Presented is a quantitative comparison of the antiradiation action of gases and low-molecular narcotics in cells of root meristem of bean sprouts. Concluded were the following: (1) Low-molecular narcotics, added to air, decrease oxygen-dependent radiation damage of the cell. (2) The protective action of low-molecular narcotics depends on their molecular volume; it decreases as the molecular volume increases. (3) Two hypotheses are offered to explain the obtained facts—persorption and diffusion. Also included in this report is the influence of cold and potassium nitrate on the antiradiation effect of compressed nitrogen. The following were concluded: (1) The lowering of temperature to 2° C or a 30-minute treatment of bean sprouts with cyanides suppresses the antiradiation action of compressed (to 20 and 25 atm) nitrogen. (2) It has been shown that the protective effectiveness of compressed nitrogen decreases with an increase of concentration of oxygen. A.L.B.

N64-27059 Joint Publications Research Service, Washington, D.C.
ADVANCES IN AEROSPACE MEDICINE AND ANIMAL SYSTEMS IN BIONICS
V. V. Parin and M. A. Mil'khiker 6 Aug. 1964 16 p refs Transl. into ENGLISH from Priroda (Moscow), v. 53, no. 5, 1964 p 20–25, 33
(JPRS-25765; TT-64-41036) OTS: $1.00

Bionics is one of the newest branches of cybernetics. The cybernetic approach to biological systems makes it possible to see those system characteristics that, when implemented mechanically, substantially accelerate scientific progress. This is shown by pointing to the high reliability of the nervous system of living organisms, to the uncommonly sensitive analyzer–analogs of data pickups in mechanical devices, and

to the ultraminiature living "instruments" for precise orientation and navigation in sea turtles, fishes, birds, and insects. Author

N64-27062 Joint Publications Research Service, Washington, D.C.
NUCLEIC ACIDS, AND VISUAL PERCEPTION: THREE STUDIES
10 Aug. 1964 25 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 155, no. 3, 1964
(JPRS-25824; TT-64-41095) OTS: $1.00

Three studies are presented on nucleic acids and visual perception: (1) characteristics of R-RNA and D-RNA of the nucleochromosomal apparatus of an animal cell; (2) the role of DNA-dependent synthesis of RNA in the activation of the genetic apparatus of differentiated cells during an increase in their physiological function; and (3) synchronous and consecutive information processing in the visual system. N.E.A.

N64-27071* National Aeronautics and Space Administration, Washington, D.C.
MEDICAL ASPECTS OF SPACE FLIGHT
Frank E. Voris [1964] 16 p
(EP-17) GPO: $0.15

The following aspects of manned space flight are discussed: major human research problems, supplying respiratory requirements, problems of acceleration forces, problems of weightlessness, radiation hazards, space flight and nutrition, collection and disposition of bodily wastes, hazards of strike and penetration by meteoroids, and psychological problems. R.T.K.

N64-27125 Joint Publications Research Service, Washington, D.C.
INTRACARDIAC INVESTIGATION OF BLOOD PRESSURE AND PHONOCARDIOGRAM IN EXPERIMENT WITH NEW SOVIET APPARATUS
N. S. Dzhavadyan et al 13 Aug. 1964 6 p refs Transl. into ENGLISH Patol. Fiziol. i Eksperim. Terapiya (Moscow), v. 7, no. 2, 1963 p 78–80
(JPRS-25897; TT-64-41168) OTS: $1.00

Results are presented of experiments on the functional characteristics of an attachment for registering intracardiac sounds and pressure, and also a precise definition of its circuit and construction. The POB-14 oscillograph was used for recording. Tests of the attachment were conducted on dogs—arterial and venous sounding of the heart through the jugular and femoral vein on the right, and through the carotid and femoral artery on the left. G.D.B.

N64-27138* National Aeronautics and Space Administration, Washington, D.C.
THE FUNCTIONAL CONDITION OF THE VESTIBULAR APPARATUS OF WHITE RATS ROTATING UNDER THE DAILY INFLUENCE OF ACCELERATION [O FUNKTSIONAL'NOM SOSTOYANII ORGANA RAVNOVESIYA U BELYKH KRYS, VYRASHCHENNYKH V USLOVIYAKH EZHEDNEVNOGO DEYSTVIYA USKORENIY]
A. A. Gyurdzhian and Z. I. Apanasenko Jul. 1964 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 156, no. 1, 1964 p 225–227
(NASA-TT-F-9025)

From the second or third day of life, one half of a litter of rats were subjected to rotation for 4 to 5 hours daily, over a period of 2 to 3 months, on a special stand with a rotation radius of 135 cm., a speed of 33 rpm, and a radial acceleration of 2 g. The second half of the litter served as a control group. Rats reared under conditions of a prolonged daily action of acceleration show a characteristic vestibulotonic reaction. The electromyographic activity of the muscles of the experimental animals in a state of comparative rest is significantly lower than the electromyographic activity of the control animals under the same conditions. The reaction of the experimental group to vestibular stimulation is markedly weaker than in the control animals. R.T.K.

N64-27263 Army Biological Labs., Fort Detrick, Md.
RADIOLOGICAL SAFETY MANUAL
A. G. Wedum Dec. 1963 88 p refs
(AD-438147)

This manual was published for the use of personnel engaged in the use, handling, storage, or disposal of radioactive materials. General rules are given for surveys of radiation areas, radiological safety instruction, and procurement of radioactive materials. Precautions necessary in the use of these materials, procedures in the event of accidents, and requirements of dosimetric methods are included. D.S.G.

N64-27264 Joint Publications Research Service, Washington, D.C.
ANTI-RAY EFFECT OF GALLATES UNDER CONDITIONS OF IRRADIATION WITH 1000 ROENTGENS
V. A. Baraboy 29 Jun. 1964 9 p refs Transl. into ENGLISH from Fiziol. Zh., Akad. Nauk Ukr. RSR (Kiev), v. 10, no. 1, 1964 p 89–93
(JPRS-25274; TT-64-31569) OTS: $0.50

Mice were given 1000 r of irradiation, causing a severe form of acute radiation sickness that resulted in the death of all of the animals 8 to 10 days after irradiation. It was found that administration of cysteamine before irradiation had no significant effect on the course of radiation sickness. Administration of propyl gallate and sodium gallate before irradiation caused an increase in the average survival time of the mice. Propyl gallate and sodium gallate also caused a definite therapeutic effect when administered immediately after irradiation. Butyl gallate had no effect on the course of the radiation sickness. R.T.K.

N64-27284* California U., Los Angeles Brain Research Inst.
RESEARCH PERFORMED IN THE SPACE BIOLOGY LABORATORY Final Report, 1 Jan.–31 Dec. 1962
[1962] 5 p refs
(Grant NsG-203-62)
(NASA-CR-58038) OTS: $1.10 ph

This is a review of several brain-research projects currently underway. A chimpanzee sleep program is described. Studies of centrifugal and vibrational stresses on brain electrical activity and concomitant behavioral performance are discussed. Presented are studies in monkeys of brain-wave patterns during exposure to cosmic rays at high altitudes. The development of EEG amplifiers for manned space flight, as well as the automatic reduction and computer analysis of EEG data are briefly summarized. G.D.B.

N64-27314* Republic Aviation Corp., Farmingdale, N.Y. Research Div.
BIOLOGICAL PASSIVE TELEMETRY
William M. Honig 30 Dec. 1963 37 p refs
(Contract NASw-789)
(NASA-CR-56942; RAC-1870; RD-P-63-586) OTS: $3.60 ph

The main kinds of active and passive biological-telemetry schemes are described. A detailed examination of a scheme for passive biological telemetry is given. This method uses an implanted device that consists of an RF-tuned circuit. The resonant frequency of this circuit is controlled by the physiological parameter of interest, e.g., a temperature-sensitive capacitor (for temperature telemetry), a pressure-sensitive inductor (for pressure telemetry), or a voltage-sensitive capacitor (for biological-voltage telemetry). An external transmitter can be arranged to illuminate the implanted device with RF power; and in conjunction with an external receiver, the resonant frequency of the implanted device, or the points in time at which variations occur, can be determined. Factors affecting operation are examined, including RF attenuation in tissue, the types of fields that can be used, frequency considerations, coupling and directionality considerations, and techniques for the telemetry of biological voltage, temperature, pressure, and pH. The size of such a device and a discussion of the factors that might permit a reduction in this size also are given. Author

N64-27318 Joint Publications Research Service, Washington, D.C.

NORMAL SPATIAL VECTORCARDIOGRAM IN LABORATORY ANIMALS (DOGS, CATS, AND RABBITS) AND METHODS FOR ITS RECORDING

Ye. Kvitnitskiy 27 Jul. 1964 11 p refs Transl. into ENGLISH from Fiziol. Zh., Akad. Nauk Ukr. SSR (Kiev), v. 10, no. 2, Mar.–Apr. 1964 p 177–182

(JPRS-25599; TT-64-31871) OTS: $1.00

This work reports the results of an investigation of normal variations of VCG elements in 36 dogs, 20 cats, and 64 rabbits. VCG recording was carried out on animals in various positions and states. Vectorcardiograms were taken by means of three-plane systems, using a VEKS-3 or a Visocard-multivector apparatus. VCG recording was carried out several times on the same animal. The most typical curves encountered in laboratory animals are presented. The dog VCG diagram was closest to that of man. The most distinct VCG elements were obtained on recording of the curves with the animals in a standing position. Author

N64-27319 Joint Publications Research Service, Washington, D.C.

THE EFFECT OF FRACTIONAL X-RAY IRRADIATION ON THE ACTIVITY OF HEXOKINASE AND ALDOLASE OF THE BRAIN AND MUSCLE TISSUE OF RATS

M. F. Silyayeva 29 Jul. 1964 17 p refs Transl. into ENGLISH from Vestsi Akad. Navuk Belarusk. SSR, Ser. Biyal. Navuk (Minsk), no. 1, 1964 p 101–106

(JPRS-25630; TT-64-31902) OTS: $1.00

Total fractional X-ray irradiation of rats in doses of 120 and 240 r causes a considerable reduction of hexokinase activity in brain tissue in a period from 15 to 60 days following irradiation. In muscle tissue hexokinase reaction increased, with a maximum on the 30th day. Aldolase activity in the brain and cerebellum decreased within 15 and 60 days after irradiation. No change of aldolase activity took place in the muscles under the effect of fractional X-ray irradiation. The most significant changes in the activity of enzymes under study were found under fractional irradiation in doses of 240 r. Author

N64-27323 Joint Publications Research Service, Washington, D.C.

ACTION POTENTIALS OF VESTIBULAR NEURONS IN CATS

O. G. Gazenko, Yu. P. Limanskiy, A. N. Razumeyev, G. V. Izosimov, V. I. Baranov et al 13 Aug. 1964 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), No. 6, 1962 p 925–928

(JPRS-25896; TT-64-41167) OTS: $1.00

The action potential of the neurons of the vestibular nuclei of the cat was recorded. The animal was in a state of immobility, and the reaction of the neurons to stimulation of the vestibular apparatus through passive vertical motion of the animal was obtained. Action potentials were recorded from 500 neurons of 17 different cats. R.T.K.

N64-27324 Joint Publications Research Service, Washington, D.C.

USE OF UREA FOR TREATMENT OF IMPAIRMENT OF THE EXCRETORY FUNCTION OF THE KIDNEYS IN BURNS

P. M. Fedonyuk 14 Aug. 1964 13 p refs Transl. into ENGLISH from Vestn. Khirurg. (Leningrad), v. 92, no. 5, May 1964 p 37–43

(JPRS-25928; TT-64-41199) OTS: $1.00

A solution of urea, introduced intravenously or enterally in the first hours after burn, prevents the death of experimental animals from burn shock and promotes removal of the sick from the state of burn shock. The medical action of urea in the initial period of burn illness is apparently connected with the fact that it depresses reabsorption of provisory urine in canaliculi, promoting an increase of urination. Therapy of acute kidney deficiency in the initial period of burn illness should be directed to the restoration of the quantity of liquid, circulating in vascular channel by means of hemotransfusion or abundant drink, and to weakening the reabsorption of provisory urine in the canaliculi of the kidneys by means of using osmotic diuretics, in particular, urea. The positive effect of the use of urea shows that the disturbances of the excretory function of kidneys in the initial period of burn illness in most cases have a reversible character. Author

N64-27335 Aerospace Industries Assn. of America, Inc., Washington, D.C. Aerospace Research and Testing Committee

RECOMMENDED SAFETY PRACTICES FOR MANNED SPACE CHAMBERS

Washington, Natl. Standards Assn., Jul. 1964 38 p refs

(ARTC-41) Natl. Standards Assn.: $1.50

Information is presented on materials and equipment to be used in the design and construction of space chambers, operating procedures, and information concerning the training of both operating personnel and test subjects. The appendixes included present specific background and supplementary information on engineering and biomedical terms, the personnel pressure suit, biomedical aspects of chamber design, and medical care of personnel suffering from exposure to a simulated space environment. R.T.K.

N64-27338 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

METABOLIC INTERCHANGES FOR MANNED SPACE FLIGHT

R. P. Cox 8 Apr. 1964 72 p refs

(SM-45905)

The dietary essentials that constitute a complete diet for normal, healthy, young adult, human males as representative of the space crews are defined. Discussed is the chemical basis of the conversion of food into body energy, by the oxidation of the carbohydrates, fats, and proteins that comprise foodstuffs and that form heat and excretory waste products. From these

criteria is derived a set of standard factors for use in calculating quantitatively the metabolic inputs and outputs of man. A series of tables, formulas, equations, and metabolic nomograms present weight and volume values for various ratios of digestible foodstuffs, water, oxygen, carbon dioxide, and metabolically produced water, and for human solid, liquid, and gaseous waste products. Author

N64-27340 Lockheed Missiles and Space Co., Sunnyvale, Calif.
IONIZING RADIATION EFFECTS ON PERFORMANCE CAPABILITIES OF ASTRONAUTS: AN ANNOTATED BIBLIOGRAPHY
Eugene E. Graziano, comp. Nov. 1963 41 p refs
(Rept.-5-59-63-1; SRB-63-13; AD-441587)

This selective annotated bibliography consists of 82 references to literature specifically relating to ionizing radiation effects on human space travelers. Immediate and long-range effects on the eyes and other tissues vital to optimum performance capabilities were of special interest. Antiradiation drugs were also of interest. The period covered in the search was from January to November 1963. Author

N64-27343 California U., Los Angeles Laboratory of Nuclear Medicine and Radiation Biology
[RESEARCH PROJECTS IN BIOCHEMISTRY, RADIOBIOLOGY, PHARMACOLOGY AND TOXICOLOGY, NUCLEAR MEDICINE, BIOPHYSICS, AND ENVIRONMENTAL RADIATION] Semiannual Progress Report, Period Ending Jun. 30, 1964
[1964] 84 p refs
(Contract AT(04-1)-GEN-12)
(UCLA-12-529)

Summaries of publications or interim research reports by the staff of the Laboratory of Nuclear Medicine and Radiation Biology are presented. M.P.G.

N64-27352* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ORGANIZATION OF THE DEOXYRIBONUCLEIC ACID REPLICATING SYSTEM IN MAMMALIAN CELLS AS REVEALED BY THE USE OF X-RADIATION AND BROMURACIL DEOXYRIBOSIDE
Robert B. Painter and Ronald E. Rasmussen Repr. from Nature, v. 201, no. 4915, 11 Jan. 1964 p 162–165 refs
(NASA-RP-245)

Among the experiments conducted were ones in which the analog of thymidine, bromuracil deoxyriboside (BUdR), was incorporated into the DNA of the cells before irradiation. The results of this treatment suggested an interpretation of the dose-dependent depression of DNA synthesis rate by X-radiation and also suggested a hypothesis concerning the subchromosomal organizations of DNA. Two kinds of cell culture were used in these investigations, HeLa *S3* and the Chinese hamster line, *DFAF*-33. Immediately after irradiation with either a 100 r/min or 300 r/min dose cultures including the sham-irradiated controls were returned to the laboratory, the media removed, and Eagle's medium containing the tracer added. Three different methods for DNA extraction were used and are described. The results of 14 experiments using 1μc/ml tritiated thymidine as the tracer for DNA synthesis in HeLa *S3* cells are presented in graphic form. Graphs of the dose response of *DFAF*-33 DNA synthesis to X-radiation and the effect of BUdR on dose response of HeLa *S3* DNA synthesis to X-radiation are presented and discussed. R.T.K.

N64-27367* National Aeronautics and Space Administration, Washington, D.C.
RADIOTELEMETRIC INVESTIGATION OF THE pH CONTENT IN THE ALIMENTARY CANAL [RADIOTELEMETRICHESKOYE ISSLEDOVANIYE pH V PISHCHEVARITEL'NOM TRAKTE]
Ye. B. Babskiy, A. M. Sorin, A. S. Belousov, I. I. Malkiman, and A. P. Nesterova Jul. 1964 5 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 156, no. 1, 1964 p 222–224
(NASA-TT-F-9026)

Studies were performed on man under clinical conditions. The subjects were usually healthy people but occasionally were patients. Either a radiocapsule that moved freely in the gastrointestinal tract, or a radiocapsule that was fastened to the end of a fine duodenal catheter was introduced into the alimentary canal. When the radiocapsule was attached to the catheter, it was possible to determine its location precisely and to detain it for awhile in one sector of the alimentary canal. Studies were carried out on an empty stomach and after the ingestion of food. When use was made of a radiopill moving freely in the alimentary canal, it was found that in normal subjects the gastric pH in an empty stomach and after the ingestion of food was within the range of 1 to 2; when the radiopill passed into the duodenum, the pH increased at once to 8 to 9; this value is steadily maintained along the entire small intestine. In the large intestine, the pH is often 5 to 6. Through the use of a radiocapsule attached to the end of the duodenal probe, studies were carried on with the introduction into the stomach of a definite amount of soda (0.5 g $NaHCO_3$ in 30 ml of water at a temperature of 38° C). Evidence is presented indicating that the introduction of a solution of soda can serve as a functional test of the intensity of secretion. R.T.K.

N64-27369* National Aeronautics and Space Administration, Washington, D.C.
MORTALITY OF RAT FETUSES (F_1) AFTER IRRADIATION OF PARENTAL (P) GAMETES WITH SMALL DOSES OF X-RAYS DURING VARIOUS PERIODS OF THEIR ONTOGENESIS [SMERTNOST' ZARODYSHEY KRYSY (F_1) POSLE OBLUCHENIYA GAMET RODITELEY (P) V RAZNYYE PERIODY IKH ONTOGENEZA NEBOL'SHIMI DOZAMI RENTGENOVSKIKH LUCHEY]
Ye. A. Dozhdayev Jul. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 156, no. 1, 1964 p 194–197
(NASA-TT-F-9036)

The work was carried out on white rats. Parents of the generation being studied were subjected to the action of X-rays at different periods of the prenatal and postnatal life: fetuses at the ages of 10, 12, 13, 15, 17, and 19 days, and newly born and young rats at 7, 14, 30, and 45 days after birth. A single total irradiation was applied in each case. It was found that the action of X-rays is especially detrimental to the offspring of irradiated females. In comparison with the irradiation of females (oocytes), the irradiation of males (male gametes) in the same period of ontogenesis evokes far fewer disturbances of embryogenesis; however, in experimental irradiation of 10- and 19-day-old fetuses of newly born and of 7-day-old rats, the total mortality in the offspring from irradiation of males and females is approximately the same. R.T.K.

N64-27395* California U., Los Angeles. Brain Research Inst.
EEG STABILITY ANALYSIS: SLEEP RECORDS
Dan Brown and John M. Rhodes [1963] 21 p refs
(Grants NsG-502; AF-AFOSR-246-63; NB-02501-03)
(NASA-CR-56908) OTS: $2.60

The concept of stability of EEG tracing is introduced as replicating one of the major factors used in clinically evaluating EEG records. Mathematical formulas for defining stability and theoretical behavior of deterministic and random processes are presented. Stability diagrams are given for typical distributions of bandwidth-duration relationships during an implanted chimpanzee sleep record, and for a group of electrode placements demonstrating separations of EEG patterns based, initially, on observed clinical categories. G.D.B.

N64-27432 Magna Corp., Anaheim, Calif. Research and Development Div.
STUDY OF HYDROGEN-FIXING MICROORGANISMS FOR CLOSED REGENERATING BIOSYSTEMS
James H. Canfield and Max D. Lechtman Wright-Patterson AFB, Ohio, AMRL, Jun. 1964 98 p refs
(Contract AF 33(657)-9633)
(AMRL-TDR-64-35; AD-603595) OTS: $2.25

The feasibility of using hydrogen-oxidizing bacteria in conjunction with electrolysis to regenerate oxygen and foodstuff from carbon dioxide and water was investigated. Results showed that 75 liters of *Hydrogenomonas eutropha* culture can fix the CO_2 and supply oxygen for one man. The cell yield is rich in proteins and deficient in carbohydrates and lipids for direct consumption by man. The feasibility of integrating the culture with the electrolysis was also investigated, with incompatibility of the bacteria with high salt content being the limiting factor. The ability of a hydrogen cathode to supply hydrogen to the culture was shown. Author

N64-27444 Air Force Systems Command, Wright-Patterson AFB, Ohio Aerospace Medical Research Labs.
FINGER DEXTERITY OF THE PRESSURE-SUITED SUBJECT
Dieter E. Walk May 1964 15 p refs
(AMRL-TDR-64-41; AD-603705)

This study attempts to establish an objective baseline for evaluating the functional mobility of pressure gloves. The Purdue Pegboard Dexterity Test was employed to measure hand dexterity under three conditions: (1) subjects barehanded, but wearing an unpressurized A/P-22S-2 full-pressure suit ensemble; (2) subjects gloved (HAK-3/P-22S-2) and suited, but not pressurized; (3) subjects gloved, suited, and pressurized to 2.5 psi. The Purdue Pegboard Dexterity Test is a delicate indicator of hand dexterity in the test conditions. The test results show a marked reduction in dexterity even with the gloves and suit uninflated, and an additional loss when gloves and suit were inflated. The degree of loss of dexterity is believed to provide an objective measure whereby one operational aspect of pressure gloves may be evaluated. Author

N64-27493 Minnesota U., Minneapolis
THORACIC CAGE IMPEDANCE MEASUREMENTS. IMPEDANCE PLETHYSMOGRAPHIC DETERMINATION OF CARDIAC OUTPUT (AN INTERPRETIVE STUDY)
Edwin Kinnen, William Kubicek, and D. Witsoe Brooks AFB, Tex., School of Aerospace Med. May 1964 16 p refs
(Contract AF 41(657)-403)
(SAM-TDR-64-23; AD-603053)

The current flux distribution in the human thorax between band electrodes placed at the base of the neck and around the lower thorax, using 100-kc excitation, was investigated to explain known correlations between the thorax electrical impedance waveforms and cardiac activity, particularly cardiac output. Measurements of the current densities around the band electrodes, equipotential surfaces constructed from both surface and interior potential measurements, externally observed directed flux impedance waveforms, and impedance properties of an approximate thorax model indicated that the major portion of electrode current flux passed through the lung tissues rather than through the blood volumes of the heart having lower resistivity. The impedance plethysmographic waveforms, obtained between the band electrodes, appeared to monitor the right ventricular stroke volume as reflected by impedance changes in the pulmonary vascular bed. Author

N64-27494 Boeing Co., Seattle, Wash.
THE EFFECTS OF MISCELLANEOUS WASTES ON MESOPHILIC ACTIVATED SLUDGE CELLULOSE
R. W. Okey, R. L. Cohen, and D. D. Chapman Brooks AFB, Tex., School of Aerospace Med. May 1964 12 p refs
(Contract AF 41(657)-387)
(SAM-TDR-64-25; AD-603055)

A broad spectrum microbial culture similar to activated sludge in utilizing cellulose has been evaluated for its ability to utilize wastes. The metabolism of cellulose was followed in Warburg and substrate depletion studies by utilizing measurements of chemical oxygen demand. Activated sludges were developed on cellulose as a sole carbon source and on human waste with added cellulose designed to simulate the waste that would be received in a remote environment. From the Warburg and substrate depletion studies, constants of first-order oxidation rate were obtained. The first-order oxidation constants were found to vary between 0.0133 and 0.0146 reciprocal hours. It was observed that a lag period varying from 400 to 1,500 minutes preceded the utilization of cellulose by the microbial system. Author

N64-27501 Joint Publications Research Service, Washington, D.C.
INFLUENCE OF GRAVITATIONAL OVERLOADS ON THE ARTERIAL SYSTEM OF THE EXTREMITAL NERVES
V. A. Otellin 29 Jun. 1964 9 p refs Transl. into ENGLISH from Arkh. Anat., Gistol. i Embriol. (Moscow), v. 46, no. 4, 1964 p 87–92
(JPRS-25275; TT-64-31570) OTS: $0.50

The successive changes that occur in the neural arterial system of the polarly oriented extremities, after exposure to gravitational overloads in different directions, are studied. It was shown that the greatest changes in the neural arterial system occur when the gravitational overloads are directed along the head–pelvis axis, and the smallest changes occur when they are directed along the transverse (chest–back) axis. Overloads in the head–pelvis direction lead to dilatation of all links in the arterial system of the nerves of the hind legs, as well as to the appearance of a larger number of vessels. Obliteration of the blood vessels occurs in the foreleg. These changes have a reversible character. Exposure to daily overloads of increasing amplitude in the head–pelvis direction leads to an increase in the capacity of the arterial channel of the nerves of the extremities. The effect of overloads on the arterial system of the perineurium, endoneurium, and epineurium is also considered. N.E.A.

N64-27503 Joint Publications Research Service, Washington, D.C.
STUDIES IN HYPERTHEMIA AND ANABIOSIS
Ye. V. Maystrakh 30 Jul. 1964 24 p Transl. into ENGLISH of portions of the book "Gipotermiya and Anabioz", Moscow, 1964 p 3–23, 285–288 refs
(JPRS-25650; TT-64-31922) OTS: $1.00

Questions pertaining to the problem of cold inhibition and cessation of vital activity in the organs of nonhibernating mammals are considered. The role of nervous mechanisms in cold suppression of vital activity was the main analysis. The influence of hypothermia on pathological processes was investigated in an effort to determine those shifts in a cooled organ that insured its increased resistance to pathogenic stimulation. N.E.A.

N64-27613* California U., Berkeley Donner Lab. of Medical Physics

HEAVY ION LOCALIZATION OF SENSITIVE EMBRYONIC SITES IN *TRIBOLIUM*

John V. Slater, John Lyman, C. A. Tobias, N. M. Amer, J. S. Beck et al Repr. from Radiation Res., v. 21, no. 4, Apr. 1964 p 541–549 refs

(NASA Order R-104)

The Berkeley heavy-ion linear accelerator was used to demonstrate that two relatively shallow sensitive sites exist in *Tribolium* that regulate wing differentiation and development. Both of these sites appear to have the same intensity and may lie within the membranous wing-base areas. It was found that, as in mice, the developmental interval during which radiation must be applied to give the greatest incidence of the malformation is restricted to a very short time period. R.T.K.

N64-27630 Joint Publications Research Service, Washington, D.C.

BIOLOGICAL STUDIES UNDER CONDITIONS OF SPACE FLIGHT AND WEIGHTLESSNESS

11 Aug. 1964 71 p refs Transl. into ENGLISH of 4 Articles from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 3, May–Jun. 1964 p 341–387

(JPRS-25844; TT-64-41115) OTS: $3.00

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1. CERTAIN RESULTS OF AND LONG-TERM PROSPECTS FOR THE DEVELOPMENT OF RADIOBIOLOGICAL RESEARCH IN SPACE N. M. Sisakyan et al p 1–15 refs (See N64-27631 19-16)

2. BLOOD CIRCULATION UNDER CONDITIONS OF WEIGHTLESSNESS I. I. Kas'yan et al p 16–41 refs (See N64-27632 19-16)

3. SENSITIVITY OF VESTIBULAR ANALYZERS AND SENSORY REACTIONS IN MAN DURING BRIEF WEIGHTLESSNESS Ye. M. Yuganov et al p 42–51 refs (See N64-27633 19-16)

4. APPLICATION OF POLAROGRAPHIC METHOD OF DETERMINATION OF OXYGEN TENSION IN TISSUES OF BRAIN DURING HIGH-ALTITUDE FLIGHT Ye. A. Kovalenko et al p 52–68 refs (See N64-27634 19-16)

N64-27631 Joint Publications Research Service, Washington, D.C.

CERTAIN RESULTS OF AND LONG-TERM PROSPECTS FOR THE DEVELOPMENT OF RADIOBIOLOGICAL RESEARCH IN SPACE

N. M. Sisakyan, V. V. Parin, V. V. Antipov, N. N. Dobrov, and P. P. Saksonov *In its* Biol. Studies under Conditions of Space Flight and Weightlessness 11 Aug. 1964 p 1–15 refs Rept. on the Sixth Intern. and Twelfth European Congr. of Aviation and Space Med., Rome, 1–5 Oct. 1963 (See N64-27630 19-16) OTS: $3.00

The results of various studies of the radiobiological effects of space flight are reviewed. Both actual flight and laboratory investigations of the relative biological effectiveness of protons and heavy nuclei of different energies, of the combined action of these particles with other space flight factors, and of the development of effective physical, biological, and pharmacological means of protection are included. The need for further studies is indicated, and the directions such studies should take are suggested. M.P.G.

N64-27632 Joint Publications Research Service, Washington, D.C.

BLOOD CIRCULATION UNDER CONDITIONS OF WEIGHTLESSNESS

I. I. Kas'yan, V. I. Kopanev, and V. I. Yazdovskiy *In its* Biol. Studies under Conditions of Space Flight and Weightlessness 11 Aug. 1964 p 16–41 refs (See N64-27630 19-16) OTS: $3.00

Results of numerous studies of the effects of weightlessness during suborbital and orbital space flight on the cardiovascular systems of men and animals are reviewed. The following conclusions are presented: (1) No essential disturbances of blood circulation result from flights in near space. (2) Experimental subjects can be divided into groups according to their pulse rate and arterial pressure response to weightlessness during flights of up to 5-days duration. (3) Changes in pulse rate and arterial pressure can be attributed to significant lowering of the hydrostatic pressure of the blood (direct influence of weightlessness) and also to disturbance of functional analyzer systems (indirect influence of weightlessness). M.P.G.

N64-27633 Joint Publications Research Service, Washington, D.C.

SENSITIVITY OF VESTIBULAR ANALYZERS AND SENSORY REACTIONS IN MAN DURING BRIEF WEIGHTLESSNESS

Ye. M. Yuganov, I. A. Sidel'nikov, A. I. Gorshkov, and I. I. Kas'yan *In its* Biol. Studies under Conditions of Space Flight and Weightlessness 11 Aug. 1964 p 42–51 refs (See N64-27630 19-16) OTS: $3.00

The value of ground-based vestibulometry methods in determining the sensitivity of human subjects to the labyrinthine effects of weightlessness (salivation, nausea, vomiting, etc.) is discussed. Two tests were found to give the most useful prognostication of the efficiency of the subject during periods of brief weightlessness: (1) the cumulation of Coriolis acceleration test and (2) the inhibition of labyrinthine reaction test. Both of these test methods are described in detail, and subjects are classified into three groups according to their degree of labyrinthine stability under weightlessness. M.P.G.

N64-27634 Joint Publications Research Service, Washington, D.C.

APPLICATION OF POLAROGRAPHIC METHOD OF DETERMINATION OF OXYGEN TENSION IN TISSUES OF BRAIN DURING HIGH-ALTITUDE FLIGHT

Ye. A. Kovalenko, V. L. Popkov, and I. N. Chernyakov *In its* Biol. Studies under Conditions of Space Flight and Weightlessness 11 Aug. 1964 p 52–68 refs (See N64-27630 19-16) OTS: $3.00

The usefulness of polarographic analysis in determining the variations of oxygen tension in the brain tissue of dogs undergoing the various hypoxic states commonly associated with high-altitude flight was investigated. Variations in oxygen tension were established, using hard platinum electrodes and continuous recording techniques, for the following conditions: compositional changes in the inhaled air, breathing of pure

oxygen as opposed to air mixtures during rapid ascent to 12 km, descent and associated decompression, acceleration, and breathing oxygen under excess pressure in the lungs. M.P.G.

N64-27636 Joint Publications Research Service, Washington, D.C.
DETECTION OF LABELLED RIBONUCLEIC ACID IN THE NERVOUS SYSTEM OF WHITE RATS
N. D. Gracheva 20 Aug. 1964 18 p refs Transl. into ENGLISH from Arkh. Anat., Gistol. i Embriol. (Moscow), no. 5, May 1964 p 3–11
(JPRS-26042; TT-64-41312) OTS: $1.00

It was shown autoradiographically that the most intensive synthesis of RNA in the nerve cells of the central and peripheral sections of the nervous system occurred in the nucleolus and the chromatin and was preceded by the appearance of labelled RNA in the cytoplasm. In the central and peripheral sections of the nervous system the labeling of the RNA of the nerve cells after the subcutaneous introduction of radioactive predecessors occurred unequally. In morphologically simple nerve cells the synthesis of RNA did not occur synchronously, apparently as a result of their different functional state. Author

N64-27649 Naval Radiological Defense Lab., San Francisco, Calif.
CHROMOSOME ABNORMALITIES IN LIVER AND MARROW OF MICE IRRADIATED WITH FAST NEUTRONS, GAMMA-, AND X-RAYS. EFFECT OF DOSE RATE
P. C. Nowell, D. Craig, F. Matthews, and L. J. Cole 21 Apr. 1964 29 p refs
(USNRDL-TR-740; AD-601115)

Low dose-rate irradiation, with either gamma-rays or fast neutrons, resulted in fewer chromosome abnormalities in liver and bone marrow than did comparable high dose-rate irradiation with X-rays or neutrons. Neutrons generally produced more aberrations than the low LET radiations, but a dose-rate effect was apparent with both types of radiation. Unstable chromosome aberrations, as well as total aberrations, were reduced in the low dose-rate groups, giving evidence of the action of an intracellular repair process. For both technical and theoretical reasons, the liver and bone marrow are not ideal systems for quantitative studies of the effects of ionizing radiation on mammalian chromosomes. In a few mice, the clonal chromosome changes provided a means of identifying myeloid cells in the liver preparations. Dividing diploid cells in both the marrow and liver showed the same chromosome change and apparently were derived from a common radiation-damaged ancestor. Author

N64-27668 Joint Publications Research Service, Washington, D.C.
UTILIZATION OF ENZYMES FOR THE DETECTION OF BIOLOGICALLY HARMFUL AGENTS
A. A. Pokrovsky 19 Aug. 1964 11 p refs Transl. into ENGLISH from Voprosy Med. Khim. (Moscow), v. IV, no. 6, Jul.–Aug. 1958 p 292–297
(JPRS-25986; TT-64-41257) OTS: $1.00

Insecticides are detected according to the suppression of the activity of cholinesterase. To do this, a standard cholinesterase preparation is brought into contact with substances suspected of contamination (water, food, air, etc.), and a comparison is made of enzyme activity before and after contact. A sharp decline of activity as a result of contact is a proof of the presence in the substance of toxicity. The determination of the activity is made by a simple colorimetric method using bromthymol blue. Graphs are given for various activity magnitudes. A.W.

N64-27670 Joint Publications Research Service, Washington, D.C.
RESULTS OF MICROWAVE TREATMENT OF SOME DISEASES
L. Nikolova-Troyeva 20 Aug. 1964 7 p ref Transl. into ENGLISH from Vopr. Kurortol., Fizioterapii i Lecheb. Fiz. Kul't. (Moscow), v. 29, no. 3, May–Jun. 1964 p 239–242
(JPRS-26038; TT-64-41308) OTS: $1.00

Microwave therapy produces good results in cases of postoperative infiltrates, myalgias, acute suppurative maxillary sinusitis, furuncles in the region of the face, arthritis deformans, and spondylarthritis and other diseases. When indicated, the combination of microwave therapy with other physical methods (therapeutic exercises, erythema doses of ultraviolet) or with medication accelerates the healing process and reinforces the therapeutic effect. Author

N64-27671 Joint Publications Research Service, Washington, D.C.
MATERIAL ON HYGIENIC CHARACTERISTICS OF INDUSTRIAL RHENIUM AEROSOL
S. V. Suvorov 21 Aug. 1964 9 p refs Transl. into ENGLISH from Gigiena Truda i Prof. Zabolevaniia (Moscow), v. 7, no. 6, Jun. 1964 p 10–13
(JPRS-26069; TT-64-41339) OTS: $1.00

Metallic rhenium dust produces no intoxication, but when introduced intratracheally it leads to the development of a mild fibrosis in the lungs of experimental animals. Rhenium condensation aerosol, in a single action involving large concentrations in the atmosphere (20 mg per cubic meter), causes acute intoxication. Animals exposed to the prolonged effect of rhenium condensation aerosol in small concentrations (6 mg per cubic meter) show mild signs of intoxication (increase of amino acid content in the urine, and depression of phosphatase activity). Metallic rhenium dust does not differ in its effect from that of wolfram dust, and therefore its maximum permissible concentration in the atmosphere may be established at the same level as for wolfram. Author

N64-27693 State U. of New York at Buffalo
NEUROLOGIC ASPECTS OF HIGH BAROMETRIC PRESSURE PHENOMENA AND THE EFFECT OF ATMOSPHERIC CONTAMINANTS UPON NERVOUS SYSTEM ACTIVITY
Final Report, 1 Nov. 1959–31 Dec. 1963
H. William Gillen et al [1963] 5 p refs
(Contract Nonr-969(04))
(AD-600259)

Rats and mice were exposed to mixtures of 35% carbon dioxide and 65% oxygen for varying periods of time. The electroencephalogram, electrocardiogram, and respiratory rate were recorded before, during, and after the exposures. The mixed venous blood, cerebral cortex, cardiac muscle, liver, and skeletal muscle were analyzed for sodium, potassium, chloride, water, carbon dioxide, phosphorous, calcium, magnesium, glucose, hydrogen ion concentration, and adenosinetriphosphate. Several series of animals were pretreated with acetazolamide (carbonic anhydrase inhibitor), THAM buffer, or isotonic saline. Oxygen-poisoning studies were also conducted in which rats were used exclusively. Extensive tests were made to determine the susceptibility of unanesthetized, unrestrained rats to oxygen poisoning as manifested by convulsions at different pressures. R.T.K.

N64-27797* Florida State U., Tallahassee Inst. for Space Biosciences

EXPERIMENTS SUGGESTING ORIGINS OF AMINO ACIDS AND PROTEINS

Sidney W. Fox Repr. from Symp. on Protein Nutr. and Metab., Spec. Publ. No. 4, Ill. U. Coll. of Agr., Urbana, Oct. 1963 14 p refs *Its* Contrib. No. 6 Previously Published as N63-11402 03-16

(Grants NsG-173-63; NIH-C-3971)

The ways in which amino acids have been produced under presumably primordial conditions are discussed. The results with amino acids first demonstrated that highly complex macromolecules can arise from relatively simple micromolecules. Results with nucleotides suggest a similar relationship. Results of experiments with amino acids and proteins are used to suggest a hypothesis whereby units as complex as primitive cells could arise. R.T.K.

N64-27799 California U., Berkeley Lawrence Radiation Lab. Donner Lab.

BIOLOGY AND MEDICINE SEMIANNUAL REPORT, SPRING 1964

John H. Lawrence, ed. and Tove Neville 1964 172 p refs

(Contract W-7405-ENG-48)

(UCRL-11387) OTS: $2.75

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9. A GALLIUM^{68} POSITRON COW FOR MEDICAL USE Yukio Yano and Hal O. Anger p 87–90 refs

10. RESPONSE OF MONKEYS TO ERYTHROPOIETIN OF RABBIT, SHEEP AND HUMAN ORIGIN Donald Van Dyke p 91–95 refs

11. WHOLE-BODY IRON LOSS IN NORMAL MAN, MEASURED WITH A GAMMA SPECTROMETER Hiroshi Saito, Thornton Sargent, Howard G. Parker, and John H. Lawrence p 96–104 refs

12. RENAL AND RETINAL VASCULAR CHANGES IN DIABETES MELLITUS John A. Linfoot, Larry W. Mc Donald, and Thomas L. Hayes p 105–113 refs

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15. BONE-GROWTH DISTURBANCE AS AN INDEX FOR RBE INVESTIGATIONS—PRELIMINARY OBSERVATIONS Giulio J. D'Angio, Alexander Gottschalk, and John T. Lyman p 140–151 refs

16. ISOLATION AND ESTIMATION OF SERUM ORGANICALLY BOUND IODINE. II. AN APPLICATION FOR DETERMINATION OF PROTEIN-BOUND IODINE (PBI) OR NON-ANIONIC IODINE (NAI) Gilles La Roche, Dorothy Carpenter, and Ann Coxworth p 152–164 refs

17. STUDIES ON CHROMOSOMES BY MEANS OF SHORT-TERM LYMPHOCYTE CULTURE William D. Loughman, H. Saul Winchell, and Myron Pollycove p 165

N64-27817* Martin Co., Baltimore, Md.

CHEMOSYNTHETIC GAS EXCHANGER Final Report, Jun. 1963–Jun. 1964

Leonard Bongers Jul. 1964 52 p refs

(Contract NASw-713)

(NASA-CR-58129; ER-13270-4) OTS: $5.60 ph

This report presents results of investigations that had as main objectives the study of physiological growth requirements and limitations of *Hydrogenomonas eutropha*. The research was directed toward the discovery of optimal conditions of growth of this organism in relatively densely populated inorganic media. Growth characteristics studied were the effect of temperature, the formation of metabolic products, the efficiency of energy conversion, and the effects of the gaseous and the inorganic substrates. Author

N64-27840 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

A METHOD OF CONTINUOUS REGISTRATION OF LOCAL CEREBRAL BLOOD FLOW IN ACUTE AND CHRONIC EXPERIMENTS

D. I. Parolla 28 Apr. 1964 5 p refs Transl. into ENGLISH from Vopr. Fiziol. i Patol. Nervnoi Sistemy, Inst. Fiziol., Akad. Nauk SSSR (Moscow), 1958 p 123–125

(FTD-TT-63-1175/1+2+4; AD-600825) OTS: $0.50

A thermistor was used for registering blood flow. The power supply to the bridge, one of the legs of which is a thermoelectrode, is increased and the thermistor (which has a low power supply) then heats. The simplicity of the attachment permitting regulation of power supplies to the bridge, and the significant gain in sensitivity (sixfold or more) in registering blood flow by thermoresistance are the advantages of this method. A.W.

N64-27844 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

IN A HEALTHY BODY, A HEALTHY SPIRIT

N. Filimonov 26 May 1964 6 p Transl. into ENGLISH from Med. Gazeta (USSR), 21 Jun. 1963 p 4

(FTD-TT-64-258/1+2+4; AD-602375) OTS: $0.50

This is a brief account of the physical effects of weightlessness on a cosmonaut. To prevent weakness from lack of

mobility within the spaceship and from the weightless condition itself. Soviet scientists propose two remedies: (1) a special suit with numerous rubber bladders alternately inflated with air and squeezing upon some part of the body; and (2) a special complex of physical exercises for the muscles. A.W.

17 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and materials fabrication, handling and inspection. *For related information see*: 06 Auxiliary Systems.

N64-27005 Air Force Systems Command, Wright-Patterson AFB, Ohio AF Materials Lab.
SUMMARY OF THE SEVENTH REFRACTORY COMPOSITES WORKING GROUP MEETING, VOLUME I
L N. Hjelm, Darrell R. James, and C. S. Lee Nov. 1963 362 p refs held at Palo Alto, Calif., 12–14 Mar. 1963
(RTD-TDR-63-4131; AD-601264)

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11. OBSERVATIONS ON METALLURGICAL BONDING BETWEEN PLASMA SPRAYED TUNGSTEN AND HOT TUNGSTEN SUBSTRATES S. J. Grisaffe and W. A. Spritzig (NASA. Lewis Res. Center) p 209–226 refs (See N64-27016 19-17)

12. REFRACTORY METAL COATING SYSTEMS UTILIZED ON A TYPICAL HYPERSONIC GLIDE REENTRY VEHICLE J. D. Culp (McDonnell Aircraft Corp.) p 227–260 (See N64-27017 19-17)

13. HIGH TEMPERATURE OXIDATION RESISTANT SYSTEMS H. W. Lavendel (Lockheed Missiles and Space Co.) p 261–295 refs (See N64-27018 19-17)

14. PASSIVE THERMAL CONTROL COATINGS J. E. Gilligan, M. E. Sibert, and T. A. Greening (Lockheed Missiles and Space Co.) p 296–340 refs (See N64-27019 19-17)

N64-27006 Chance Vought Corp., Dallas, Tex.
IMPROVED PROCESSING TECHNIQUES PROVIDE APPLICATION VERSATILITY FOR VOUGHT'S HIGH TEMPERATURE OXIDATION RESISTANT COATING SYSTEMS
W. L. Aves, Jr. *In* AFSC Sum. of the 7th Refractory Composites Working Group Meeting, Vol. I Nov. 1963 p 1–27 (See N64-27005 19-17)

A brief outline of the current application techniques to improve coating continuity, applicability, and system reliability is provided. Processing techniques designated "slip-pack" and "segregated-pack" are described. The application of tailored high-temperature oxidation-resistant coating systems to refractory metal substrates by use of pyrophoric or thermit heat sources are presented. Author

N64-27007 Chromalloy Corp., West Nyack, N.Y.
ACTIVITIES OF CHROMALLOY DIVISION IN THE DEVELOPMENT OF COATINGS FOR REFRACTORY METALS
Martin Epner *In* AFSC Sum. of the 7th Refractory Composites Working Group Meeting, Vol. I Nov. 1963 p 28–41 (See N64-27005 19-17)

The effect of low pressures on the oxidation protection of silicide coatings on molybdenum, and the semiproduction coating of various molybdenum components are discussed. It was found that the average life of W-3 coated molybdenum specimens is 3 hours at 3,000° F and is in excess of 200 hours at 2,700° F. A series of various types of hardware made of molybdenum were coated, and the results of the oxidation testing performed are discussed. R.T.K.

N64-27008 Battelle Memorial Inst., Columbus, Ohio
SILICIDE COATINGS FOR TANTALUM-BASE ALLOYS
H. R. Ogden, J. B. Hallowell, and D. J. Maykuth *In* AFSC Sum. of the 7th Refractory Composites Working Group Meeting, Vol. I Nov. 1963 p 42–50 (See N64-27005 19-17)

Results are presented of studies directed toward the development of silicide coatings for the oxidation protection of tantalum-base alloys. Vanadium was found to be the most beneficial modifier for silicide coatings on tantalum alloys and was effective at both low (1,200° to 1,800° F) and high (2,500° to 2,700° F) temperatures. Boron additions, in combination with vanadium, gave further improvements in the degree of protection at both 1,800° and 2,700° F. However, at the boron levels investigated, substrate bend embrittlement occurred as a result of the presence of an intergranular boron-rich phase. The capabilities of the straight silicide coating on Ta-30Cb-7.5V alloy included useful lives in cyclic oxidation testing through 2,900° F, resistance to thermal shock and oxidation in torch tests up to 3,000° F, and protection during 1 1/2-percent plastic deformation in air at 2,200° F. R.T.K.

N64-27009 General Telephone and Electronics Labs., Inc., Bayside, N.Y.
HIGH-TEMPERATURE PROTECTIVE COATINGS FOR REFRACTORY METALS. PART I: DEVELOPMENT OF OXIDATION RESISTANT COATINGS FOR REFRACTORY METALS
L. Sama *In* AFSC Sum. of the 7th Refractory Composites Working Group Meeting, Vol. I Nov. 1963 p 51–65 ref (See N64-27005 19-17)

An extensive evaluation of the effectiveness of the tin–aluminum spray slurry coating process was conducted on Ta-10W, Ta-30Cb-7 1/2V, and Cb-5Zr. Data covering stress rupture evaluations, oxidation tests, and reduced-pressure-environment tests are presented for 0.040-in.-thick Ta-10W and 0.020-in.-thick Ta-30Cb-7 1/2V. The results of studies on coating stability in the range of 1 to 15 mm of air pressure and on the effect of weight changes in coated samples at reduced air pressures are reported. R.T.K.

N64-27010 General Telephone and Electronics Labs., Inc., Bayside, N.Y.
HIGH-TEMPERATURE PROTECTIVE COATINGS FOR REFRACTORY METALS. PART II: EXPERIMENTAL STUDY OF FACTORS IMPORTANT IN THE PROTECTION OF TUNGSTEN ABOVE 1900°C
C. D. Dickinson *In* AFSC Sum. of the 7th Refractory Composites Working Group Meeting, Vol. I Nov. 1963 p 66–113 refs (See N64-27005 19-17)

Experiments were performed to determine if the use of a liquid substrate could prevent breakaway in the growth of various refractory oxides by preventing the transmission of stress or strain from the substrate to the oxide. The growth of HfO_2 and ZrO_2 from a Hf or Zr alloy substrate was studied, using both tin and gold as a diluent. Growth of ThO_2 and Al_2O_3 from Th and Al alloys was investigated, using only tin as a diluent. Ternary diffusion was studied in the Zr-Th-O system. A brief description of the results obtained and a discussion of these results are presented. R.T.K.

N64-27011 Pfaudler Co., Rochester, N.Y.
RESEARCH IN PROTECTIVE COATINGS FOR REFRACTORY METALS
P. J. Chao, G. J. Dormer, B. S. Payne, Jr., J. B. Whitney, and J. Zupan *In* AFSC Sum. of the 7th Refractory Composites Working Group Meeting, Vol. I Nov. 1963 p 114–126 (See N64-27005 19-17)

Experimental work is summarized in the following areas: (1) manufacturing methods for high-temperature coating of large molybdenum parts; (2) development of novel practical techniques for applying oxidation-resistant coatings to columbium alloys; and (3) coatings for columbium- and tantalum-base alloys. R.T.K.

N64-27012 General Dynamics/Fort Worth, Tex.
HIGH TEMPERATURE PROTECTIVE COATINGS DEVELOPMENTS
J. E. Burroughs and P. F. Ghena *In* AFSC Sum. of the 7th Refractory Composites Working Group Meeting, Vol. I Nov. 1963 p 127–140 (See N64-27005 19-17)

Saturated solutions of PVA (polyvinyl alcohol) in water, methyl alcohol, isopropyl alcohol, and acetone were found to be unsatisfactory for coating application. In the application of slurry dipped coatings, tantalum alloys were more easily coated than columbium-base alloys. A composition of 50Al-50Sn was found to be more resistant to oxidation than 75Sn-25Al, but the latter was a more easily applied coating. A basic tin-aluminum coating was modified with additions of copper, chromium, titanium, and zirconium. Titanium and zirconium were not absorbed into the alloy on diffusion, when added as elemental powders. Chromium and titanium additions formed a visible oxide very quickly but seemed resistant to further oxidation. R.T.K.

N64-27013 Solar, San Diego, Calif.
EVALUATION OF COATED REFRACTORY METAL FOILS
A. R. Stetson and V. S. Moore *In* AFSC Sum. of the 7th Refractory Composites Working Group Meeting, Vol. I Nov. 1963 p 141–184 ref (See N64-27005 19-17)
(Contract AF 33(657)-9443)

On the basis of the experiments conducted, it could not be concluded that one of the silicide coatings tested was better than another. If coating life is plotted against thickness, the thickest coatings have the longest life. The high-boron coatings are not as protective at 2,500° F as silicide coatings with more refractory modifiers. Aluminum-based coatings have high diffusion rates and are generally not as protective at 2,500° F as the silicide coatings, particularly on the columbium-based alloys. Fusion welding and brazing appeared to be the only satisfactory methods for joining foil structures prior to coating. Bonding methods, such as resistance welding, that do not completely bond the faying surface cannot be reliably coated by pack cementation processes due to throwing-power limitation. R.T.K.

N64-27014 General Dynamics/Pomona, Calif.
DEVELOPMENT AND EVALUATION OF REFRACTORY METAL COATINGS
R. L. Halise, S. C. Colburn, and R. E. Mihalco *In* AFSC Sum. of the 7th Refractory Composites Working Group Meeting, Vol. I Nov. 1963 p 185–202 (See N64-27005 19-17)

Research activities are reported in the following areas: (1) the development of silicide coatings for columbium and tantalum; (2) elevated temperature creep testing of coated 0.5Ti-Mo alloys; and (3) performance tests on coated FS-82 columbium alloys. R.T.K.

N64-27015 IIT Research Inst., Chicago, Ill.
PLASMA-SPRAYED OXIDE AND VAPOR-DEPOSITED NITRIDE COATINGS ON TUNGSTEN AS A MEANS OF ACHIEVING OXIDATION PROTECTION
J. L. Bliton and J. J. Rausch *In* AFSC Sum. of the 7th Refractory Composites Working Group Meeting, Vol. I Nov. 1963 p 203–208 (See N64-27005 19-17)
(Contract NAS7-113)

Current studies in which attempts were made to utilize refractory oxide and nitride coatings as a means of protecting tungsten from oxidation are described. Oxide coatings were applied by plasma spraying, and the nitride coatings were applied by chemical vapor deposition. Results are reported in the following areas: (1) plasma-sprayed oxide coatings—coating-to-substrate bond strength, coating systems, and oxidation testing; and (2) pyrolytic nitride coatings—hafnium nitride dissociation studies and oxidation testing. R.T.K.

N64-27016* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
OBSERVATIONS ON METALLURGICAL BONDING BETWEEN PLASMA SPRAYED TUNGSTEN AND HOT TUNGSTEN SUBSTRATES

S. J. Grisaffe and W. A. Spitzig *In* AFSC Sum. of the 7th Refractory Composites Working Group Meeting, Vol. I Nov. 1963 p 209–206 refs Previously Published as NASA-RP-41; see N64-10286 01–24 (See N64-27005 19-17)
(NASA-RP-41)

Results of an examination of plasma-sprayed particles on preheated substrates over a substrate temperature range of 2,050° to 2,700° F are reported. Also reported are the examination results of the coating substrate cross sections. It was found that metallurgically bonded tungsten coatings can be achieved by plasma spraying on polished tungsten substrates, without prior roughening of the substrate surface, if the substrate is first heated in an inert atmosphere. It is possible to deposit such coatings while retaining the high-strength properties of an as-worked substrate; i.e., a metallurgical bond can be achieved at a substrate temperature below the substrate recrystallization temperature. The type of columnar grains appearing in all the cross sections indicates that the coating-substrate bond is the result of substrate surface grains growing into the coating. Even under very short-time conditions, almost complete elimination of the original coating-to-substrate interface can be achieved. R.T.K.

N64-27017 McDonnell Aircraft Corp., St. Louis, Mo.
REFRACTORY METAL COATING SYSTEMS UTILIZED ON A TYPICAL HYPERSONIC GLIDE RE-ENTRY VEHICLE
J. D. Culp *In* AFSC Sum. of the 7th Refractory Composites Working Group Meeting, Vol. I Nov. 1963 p 227–260 (See N64-27005 19-17)

The refractory metal coating systems employed on a hypersonic glide reentry research vehicle that is being designed and fabricated are described, and the evolution of these metal coating systems is summarized. Zirconium oxide is used at the nose cap, and aluminum is used in the instrumentation package and innerstage. The nose assembly is composed of a zirconia nose cap attached to a molybdenum nose skirt by means of a molybdenum bulkhead. Forward leading edges are of siliconized graphite, and the aft two leading edges are of columbium. The forward lower body is made of molybdenum heat shield panels, and the aft lower body is of columbium heat shield panels. The forward upper body is a modified conic, single-faced corrugated assembly fabricated from columbium. The aft upper body is of a similar design and is fabricated from L-605. Columbium and titanium compose the primary structure. The forward bulkhead, side beams, aft beam, and trusses are of columbium, and the stringers, floor, and aft bulkhead are of titanium. The interstage assembly, which does not reenter with the vehicle, is made of aluminum. R.T.K.

N64-27018 Lockheed Missiles and Space Co., Palo Alto, Calif.
HIGH TEMPERATURE OXIDATION RESISTANT SYSTEMS
H. W. Lavendel *In* AFSC Sum. of the 7th Refractory Composites Working Group Meeting, Vol. I Nov. 1963 p 261–295 refs (See N64-27005 19-17)

The following topics are discussed: behavior of silicide coatings in high-temperature–low-pressure environment, high-temperature behavior of $MoSi_2$ in vacuum, and oxidation of graphite and various types of carbon. R.T.K.

N64-27019 Lockheed Missiles and Space Co., Palo Alto, Calif.
PASSIVE THERMAL CONTROL COATINGS
J. E. Gilligan, M. E. Sibert, and T. A. Greening *In* AFSC Sum. of the 7th Refractory Composites Working Group Meeting, Vol. I Nov. 1963 p 296–340 refs (See N64-27005 19-17)

The development, testing, and evaluation of inorganic optical coatings are discussed. Silicate coating systems for solar reflectors and flat absorber coatings are described. Continuously variable coating systems that are composites of solar reflector and flat absorber coating, ceramic, plasma, flame spray, and anodic coatings are described. The variation of coatings with physical properties, the optical evaluation of coatings, and ultraviolet and nuclear radiation testing of coated specimens are discussed. R.T.K.

N64-27046 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
JOINTING OF METAL ARMATURES WITH PORCELAIN SLEEVES
Jaromir Mracek *In its* The Glass and Ceramics Worker 14 Mar. 1963 p 8–15 (See N64-27044 19-19)

This report discusses briefly the technology of jointing ceramic materials, particularly porcelain, to metal by soldering, for use primarily in electrical components. Of four known methods for jointing ceramics to metals, soldering is the most reliable and has proven strength, durability, and airtightness. Since metal cannot be directly jointed to ceramics, it is necessary to coat the ceramic material with a firmly adhering metal layer before soldering. Silver has proven to be a functional metal for this purpose. Methods for using silver-coated ceramics to make acceptable soldered passages (ducts) are described. J.L.C.

N64-27073 General Electric Co., Schenectady, N.Y. Tube Dept.
PRODUCTION ENGINEERING MEASURE FOR VOLTAGE-TUNABLE MAGNETRONS Seventh Quarterly Progress Report, 18 Oct. 1963–18 Jan. 1964
E. G. Soulier [1964] 20 p refs
(Contract DA-36-039-SC-86722)
(QPR-7; AD-600094)

The various problem areas and their solutions are stated for two package types. The results and conclusions of the filament-growth investigation are discussed. The latest yield percentages obtained for the basic tube assembly are given. The status of the preproduction run for the ZM-6103 and ZM-6104 packages is described. Results in the quality-control area on the procedures for procuring filaments are given. Author

N64-27083 Syracuse U. Research Inst., N.Y.
EFFECT OF SECTION SIZE ON NOTCH TENSILE STRENGTH Interim Technical Report No. 2
G. T. Schaeffer and V. Weiss Jun. 1964 93 p refs
(Contract DA-31-124-ARO(D)-106)
(SURI-MET-1078-664-12; AROD-3136-3; AD-442511)

The effect of section size on the notch tensile strength of H-11 steel, 2014-T6 and 7075-T6 aluminum and plexiglass was investigated. Three test series were conducted on notched specimens. Smooth and fatigue-cracked tensile specimens were also tested for the H-11 steel and the two aluminum alloys. The notch strength decreases with increasing size for all series investigated. The decrease is most pronounced for the sharp notch and fatigue-crack series, but it is also observed, to a much smaller degree, in the other series of notched specimens for all materials. An analysis of the results indicates that the loss in strength with increasing size is due to at least two factors: increase in stress concentration factor and increase in critically stressed volume with increasing size. Size effect and experimental scatter are dependent on the absolute size of the critically stressed volume as well as the inherent material inhomogeneity. Author

N64-27091 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE PROBLEM OF SELECTING MIRROR MATERIAL AND THE POSSIBILITY OF USING CERAMICS FOR MIRRORS
Yang Shih-Ching (Tze-Ching-Shan Obs., Chinese Acad.) *In its* Acta Astron. Sinica (Selected Articles) 3 Jun. 1964 p 11–19 refs (See N64-27089 19-15)

The paper sets forth requirements to be met by mirror materials, the Matsutov coefficient ψ, and w for evaluation of materials as regards temperature strains and relative mirror weight. The properties of porcelain, which are listed in a table, and the possibility of using procelain mirrors are examined. The preliminary results of experimentation with such a mirror are set forth at the end of the paper. Author

N64-27142 Hanford Atomic Products Operation, Richland, Wash. Hanford Labs.
THIN WALL TUBING TESTS USING ULTRASONIC SHEAR WAVES. PART I: THEORY OF ULTRASONIC WAVE PROPAGATION, EXPERIMENTAL DATA, AND NOTCH FABRICATION
M. F. Zeutschel and N. E. Dixon 12 Jun. 1964 50 p refs
(Contract AT(45-1)-1350)
(HW-81956) OTS: $1.25

Broadband narrow-beam ultrasonic equipment and inspection techniques are described. This equipment generates shear waves for testing thin wall tubing or plates. A description of shear waves and their relationships to more complex Lamb waves is presented. Also presented are notch depth versus signal amplitude curves obtained at a variety of ultrasonic incident angles. These curves demonstrate the test sensitivity, capability, and limitations in tubes ranging from 12 to 65 mils in wall thicknesses of aluminum, Zircaloy, and stainless steel. Defects down to 1 mil in depth by 15 mils in length are reliably detected, whereas notches of increasing depth are detected with continuously increasing signal amplitudes. Author

N64-27191 Grumman Aircraft Engineering Corp., Bethpage, N.Y.
EFFECTS OF LUBRICATION AND SURFACE FINISH ON FRICTION AND SEIZURE OF PLAIN THRUST BEARING MATERIALS
Dennis J. Hearon and W. D. Craig, Jr. Mar. 1964 35 p refs
(ADR-05-06-64.1)

This investigation was made to find methods of improving the galling resistance of skewed axis wing-fold fittings and other thrust surfaces. Friction and seizure load tests were made with oscillating grease lubricated plain steel thrust bearings to determine the effect of material combinations, surface finishes, and type of lubricant. Various combinations of 4330 V. Modified, H-11, 440C, Nitralloy, and Graph-Mo steels were oscillated under load through 90°. Surface finishes used were 16 and 63 microinch roughness with and without grit blasting. Diester base greases with and without 5% MoS_2 and petroleum base grease with 70% MoS_2 were tested. With a gradual break-in using increasing loads, best performance was obtained with Graph-Mo against Graph-Mo steel and a 5% MoS_2 diester grease (MIL-G-21164). In all cases involving break-in, like materials were superior to dissimilar metal combinations. A grit blasted surface delayed the onset of galling at high loads for bearings that were not gradually broken in. Designs loads and friction ranges are shown in tabular form for various material combinations of common aircraft steels. Recommended relubrication intervals are shown. Author

N64-27220 Lockheed-Georgia Co., Marietta Scientific and Technical Information Department
BIBLIOGRAPHY ON RELIABILITY
Harold S. Sharp Jun. 1964 27 p refs

N64-27236 Avco Corp., Stratford, Conn. Lycoming Div.
METASTABLE AUSTENITIC FORMING OF HIGH STRENGTH PRESSURE VESSELS Interim Technical Progress Report, 1 Apr.–30 Sep. 1963
J. M. Raymer 15 Oct. 1963 49 p refs
(Contract AF 33(657)-7955)
(SAR-3; AD-438009)

Detailed analysis of the effects of the various processing parameters was obtained from the full factorial experiment of the 18 NiCoMo (300) maraging steel. From these analyses, an optimum combination of processing parameters was derived and incorporated in the processing schedule of the intermediate size cylindrical test specimen. All necessary forgings in 18 NiCoMo (300) maraging steel and tooling for fabrication were obtained, and two 14.5-in.-diam cylindrical test bottles were spun to verify the results obtained earlier. Author

N64-27266 Joint Publications Research Service, Washington, D.C.
A HIGHER ORDER OF CYBERNETIC MACHINES [KIBERNETICHESKIYE MASHINY VYSSHEGO RANGA]
L. I. Sharol' 14 Aug. 1964 35 p Transl. into ENGLISH from Novoye v Zhizne, Nauke, Tekhn. (Moscow), ser. 4, no. 24, 1963 p 1–39
(JPRS-25927; TT-64-41198) OTS: $2.00

Machines capable of controlling entire industrial complexes (railroad junctions, workshops, combines, etc.) are discussed. As an example, a machine that controls the activities of the heating workshop of a metallurgical concern is described in detail. The problems of training cybernetic specialists and the economic foundation of cybernetic technology are discussed. R.T.K.

N64-27305* General Electric Co., Schenectady, N.Y. Advanced Technology Labs.
DESIGN CRITERIA FOR ZERO LEAKAGE CONNECTORS FOR LAUNCH VEHICLES. FUNDAMENTAL SEAL INTERFACE STUDIES AND DESIGN AND TESTING OF TUBE AND DUCT SEPARABLE CONNECTORS Final Report, Mar.–Dec. 1963
F. O. Rathbun, Jr. 1 Jun. 1964 275 p
(Contract NAS8-4012)
(NASA-CR-56571) OTS: $17.50

The effects of gasket material properties and geometry on leakage flows, and the testing of the validity of the design principles for zero leakage connectors are investigated. The seal-interface study included experiments conducted on commercially available gaskets, gasket materials, and direct contact sealing surfaces. The design, fabrication, and testing of a 4-inch, high-temperature flanged connector, a 12-inch, cryogenic flanged connector, and two types of tube connectors are presented. D.S.G.

N64-27310* Midwest Research Inst., Kansas City, Mo.
RESEARCH ON BEARING LUBRICANTS FOR USE IN HIGH VACUUM Annual Summary Report, 23 Apr. 1963–22 May 1964
Vern Hopkins, D. H. Gaddis, R. D. Hubbell, and F. W. Holm 5 May 1964 49 p refs
(Contract NAS8-1540; MRI Proj. 2492-E)
(NASA-CR-58039) OTS: $4.60

The wear life of a potassium silicate binder material was increased by the addition of sodium fluoride. A solid lubricant film composed of MoS_2, graphite, gold, and potassium silicate modified with sodium fluoride exhibited friction characteristics similar to those of MLF-5 and longer wear life (in air) than that of MLF-5. A description of six newly designed and fabricated wear-life testers is presented. MLF-5 exhibited friction coefficients as low as 0.04 at room temperature, in air, and at loads to 150,000 psi. An ultrahigh-vacuum apparatus was built and attained an ultimate pressure of 1.6×10^{-13} torr. The preliminary design of a multistation vacuum friction apparatus is presented and discussed. Author

N64-27311* Pratt and Whitney Aircraft, West Palm Beach, Fla. Florida Research and Development Center

RESEARCH AND DEVELOPMENT OF MATERIALS FOR USE AS LUBRICANTS IN A LIQUID HYDROGEN ENVIRONMENT Summary Report

W. C. Keathley and E. W. Dwyer 18 Jun. 1964 89 p refs

(Contract NAS8-11537)

(NASA-CR-56947; PWA-FR-986) OTS: $8.10

A program was conducted to evaluate materials that can be used as lubricants in antifriction bearings operating in a liquid hydrogen environment at DN values from 2×10^6 to 4×10^6 mm-rpm. Even though no tests were conducted in a nuclear radiation field, consideration was given to such an environment in the selection of some of the candidate materials. The program described resulted in the discovery of a material that provides a significant increase in the possible bearing life when operating under the above conditions. Author

N64-27337 General Electric Co., Cincinnati, Ohio Advanced Technology Services

HIGH-TEMPERATURE MATERIALS AND REACTOR COMPONENT DEVELOPMENT PROGRAMS. VOLUME I: MATERIALS Third Annual Report, 1 Jan. 1963–31 Jan. 1964

28 Feb. 1964 161 p refs

(Contract AT(40-1)-2847)

(GEMP-270A) OTS: $2.75

Research is reported in the following areas: (1) materials for use as fueled and nonfueled, high-temperature (1,000° to 3,000° C) reactor components; (2) radiation effects on the time, temperature, and stress-dependent properties of selected high-temperature alloys and refractory metals; (3) radiation effects in BeO as a function of composition, grain size, density, porosity, and irradiation temperature and dosage; (4) the diffusion of fission gases (Kr, Xe, and I atoms) in ceramic oxides subsequent to their injection via ion bombardment; (5) the fission-product transport processes in refractory-metal fuel systems at temperatures exceeding 1,700° C; and (6) the chemistry involved in the use of a fertile material (thoria) in stabilized-fuel–BeO systems, and the development of such systems as natural conversion fuel elements. Among the significant results are the following. Creep-rupture tests were performed on some of the refractory metals and alloys to 2,800° C in hydrogen and argon atmospheres from 1 to 1,000 hours. An improved processing and fabrications procedure for W-25Re sheet was developed. At reactor ambient temperature, irradiation or recrystallized tungsten to a fast neutron dose of 2.5 to 3.2×10^{19} nvt reduced the creep rate by a factor of 2, and increased the stress-rupture life at 1,100° C by a factor of 2.6. Expansion was found to be the principal effect of irradiation in BeO. R.T.K.

N64-27339 Union Carbide Corp., Parma, Ohio Carbon Products Div.

RESEARCH PROGRAM TO OBTAIN COMPREHENSIVE DESIGN CRITERIA FOR GRADE CFW GRAPHITE Quarterly Progress Report, Mar. 1–May 31, 1964

P. G. Lafyatis Wright-Patterson AFB, Ohio, AF Materials Lab., 15 Jun. 1964 40 p

(Contract AF 33(657)-11329)

(AD-441918)

Data for deriving design criteria for grade CFW graphite are to be obtained from two cylinders, 103 in. in OD by approximately 34 in. in ID by 35 in. in length. This report describes the radiographic inspection and sampling of the cylinders, the results of a feasibility study of an optical method for measuring transverse strain in tension and compression, the refinement of equipment for measurement of thermal conductivity, and the evaluation of a flagged compressive specimen for measurement of longitudinal strain by an optical method. Some room-temperature ultimate tensile strength and stress–strain data are reported for one of the cylinders. Author

N64-27347 Texas Instruments, Inc., Dallas Semiconductor-Components Div.

PRODUCTION ENGINEERING MEASURES TO IMPROVE TRANSISTOR RELIABILITY Quarterly Progress Report, 1 Oct.–31 Dec. 1963

Doyce Briggs, M. L. Anderson, R. L. Petritz, and Don Manus [1964] 11 p

(Contract DA-36-039-SC-86730)

(QPR-6; AD-600283)

Progress in improving transistor reliability was divided into the following areas: (1) finding and evaluating weak points in design; (2) changing device design where reliability can be improved without increasing cost; (3) evaluating and changing the manufacturing process where it will effect an improvement in transistor reliability; and (4) producing devices that incorporate the process changes and place on reliability testing. Device design was evaluated, and some modifications were incorporated as reported in previous reports. Process improvements were designed and evaluated regarding effect on product reliability. Two improvements were incorporated into a first group, and these devices were placed on life and environmental test. Units with a total of 19 process changes are being built and will be placed on test for evaluation. Author

N64-27409 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

STUDY OF TITANIUM ALLOY TANKAGE AT CRYOGENIC TEMPERATURES

W. J. Martin, T. Matsuda, and E. F. Kaluza 5 May 1962 77 p refs

(SM-43116)

A project was initiated to develop titanium pressure vessel fabrication and welding methods. Using Ti-6Al-4V and Ti-5Al-2.5Sn alloys and incorporating three weld designs, a total of eight 16-in.-diam pressure vessels were manufactured and burst tested at temperatures between ambient and −423° F (−253° C). In addition, three 30-in. cylinders of sandwich construction were fabricated and tested under selected thermal gradients. The results showed that resistance of fusion welded Ti-6Al-4V tankage can be manufactured and used at temperatures between ambient temperature and −320° F (−196° C). The compressive strengths of sandwich cylinders varied little within the range of the thermal gradients investigated. Information on the fabrication and testing methods as applied to titanium tankage is presented in this report. The possible causes of premature failure at −423° F (−253° C) and the subject of "texture strengthening" are briefly discussed. Author

N64-27529 General Dynamics/Astronautics, San Diego, Calif.
ADVANCED BALLISTIC RE-ENTRY SYSTEMS RELIABILITY REPORT
J. M. Farrar 15 Apr. 1964 51 p ref
(Contract AF 04(694)-238)
(GD/A-DDH64-021; AD-440756)

To date, efforts to satisfy reliability objectives have led to the following conclusions: (1) A large percentage of the AGE failures are the result of old equipment. (2) Operating procedures for prelaunch operations are adequate from a reliability standpoint. (3) The minor types of failures being reviewed do not warrant hardware redesigns unless they should occur at frequent intervals. (4) Hardware redesigns can normally be justified only through the failure analysis activity, which is mainly concerned with critical and major type failures. Some degree of review of failures at all levels is considered essential to insure effective identification of all significant problem areas and elimination of preventable failures. Author

N64-27590 Boeing Co., Seattle, Wash.
DEVELOPMENT AND EVALUATION OF COATINGS FOR EARTH RE-ENTRY SYSTEMS
E. G. Czarnecki and M. T. Braun *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 357–368 refs (See N64-27576 19-18) Pergamon: £ 7

Since reentry coatings must function through the complete flight cycle of boost, orbit, and reentry, the primary emphasis is placed upon the temperatures, pressures, gas states, strains, mass transfer, time, and other parameters experienced during the reentry portion of the mission. After a brief discussion of the requirement to consider the coating and parent material as a single system, the principal requirements of the coated material in terms of oxidation protection at temperature, emittance, and chemical compatibility are presented. The methods of application of disilicide coatings to molybdenum and columbium are compared. Facilities capable of simulating portions of the environment, including plasma jets, vacuum chambers, wind tunnels and others, are discussed, and the degree of simulation available from each facility is compared. Typical test data from advanced methods of application are presented, including emittance, oxidation life, and chemical compatibility. Author

N64-27617 Joint Publications Research Service, Washington, D.C.
ELECTROSLAG WELDING AND REMELTING
V. P. Didkovskiy et al 6 Aug. 1964 32 p refs Transl. into ENGLISH of 4 Articles from Avtomat. Svarka (Kiev), no. 2, Feb. 1964 p 54–58, 67–71, 72–74, 77–80
(JPRS-25757; TT-64-41028) OTS: $2.00

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2. ELECTROSLAG WELDING OF LOW-ALLOY STEEL 16GS(3N) WITH A THICKNESS OF 50-140 mm S. V. Yunger and G. N. Gorkunenko p 10–18 refs (See N64-27619 19-17)
3. BEHAVIOR OF DROP AND SURFACE OF THE MOLTEN BATH IN ELECTROSLAG REMELTING V. V. Panin, O. B. Borovskiy, I. S. Ivakhnenko, and S. A. Iodkovskiy p 19–23 (See N64-27620 19-17)
4. GUARANTEE OF PRECISE DIMENSIONS OF CYLINDRICAL PARTS IN ELECTROSLAG WELDING I. I. Sushchuk-Slyusarenko, V. M. Khrundzhe, and S. Ya. Shekhter p 24–30 refs (See N64-27621 19-17)

N64-27618 Joint Publications Research Service, Washington, D.C.
ELECTROSLAG WELDING OF FORGINGS OF ALLOY VT6
V. P. Didkovskiy, V. F. Grabin, and S. M. Gurevich *In its* Electroslag Welding and Remelting 6 Aug. 1964 p 1–9 refs (See N64-27617 19-17) OTS: $2.00

Ways are studied of increasing plasticity of the buildup metal during electroslag welding of forgings of alloy VT6. An electrode from integrally alloyed titanium alloy AT8 is proposed, which insures equal strength of the joint and the base metal, high plasticity, and tenacity of the seam metal. Also proposed is a composite electrode made of strips of alloys VT1 and VT6. Author

N64-27619 Joint Publications Research Service, Washington, D.C.
ELECTROSLAG WELDING OF LOW ALLOY STEEL 16GS (3N) WITH A THICKNESS OF 50-140 mm
S. V. Yunger and G. N. Gorkunenko *In its* Electroslag Welding and Remelting 6 Aug. 1964 p 10–18 refs (See N64-27617 19-17) OTS: $2.00

Presented are results of an investigation of rational conditions of electroslag welding steel 16GS (3N). Recommendations are given about selection of electrode wire. Detailed information is given about mechanical properties of the seam and the seam-adjoining zone. Author

N64-27620 Joint Publications Research Service, Washington, D.C.
BEHAVIOR OF DROP AND SURFACE OF THE MOLTEN BATH IN ELECTROSLAG REMELTING
V. V. Panin, O. B. Borovskiy, I. S. Ivakhnenko, and S. A. Iodkovskiy *In its* Electroslag Welding and Remelting 6 Aug. 1964 p 19–23 (See N64-27617 19-17) OTS: $2.00

Presented are results of the study of the electroslag remelting process of expended electrodes by using X-ray radioscopy with crystallizer and slag bath. In studying the processes connected with the formation of drop with its movement through slag and behavior of liquid metallic bath during electroslag remelting, a method of X-ray transillumination was applied. The source of radiation utilized was roentgen apparatus. During transillumination, visual observation of the process of electroslag remelting was carried out. Author

N64-27621 Joint Publications Research Service, Washington, D.C.
GUARANTEE OF PRECISE DIMENSIONS OF CYLINDRICAL PARTS IN ELECTROSLAG WELDING
I. I. Sushchuk-Slyusarenko, V. M. Khrundzhe, and S. Ya. Shekhter *In its* Electroslag Welding and Remelting 6 Aug. 1964 p 24–30 refs (See N64-27617 19-17) OTS: $2.00

Described is a method of assuring exact dimensions of welded articles that will apply during electroslag welding of articles of right-angle section. However, in practice it is often necessary to join parts of other geometrical form—rollers, base rollers of rolling mills, big machine, shafts, and other articles having a cylindrical form in the place of a break. Author

N64-27635 Joint Publications Research Service, Washington, D.C.
CRITIQUE OF LITERATURE ON BRAZING
I. Il'yevskiy 20 Aug. 1964 18 p refs Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow), no. 5, May 1964 p 36–40, 45
(JPRS-26036; TT-64-41306) OTS: $1.00

The causes of braze fractures in the process of brazing are discussed, and the laws of diffusion processes that occur during the reaction of braze materials with metals are examined. Various theories concerning the nature of brazing are discussed. R.T.K.

N64-27643 Southern Research Inst., Birmingham, Ala.
THE DEVELOPMENT AND EVALUATION OF HEAT-RESISTANT, RAIN-EROSION-RESISTANT COATINGS Bi-Monthly Progress Report No. 5, 26 Feb.–26 Apr. 1964
R. B. Perkins 15 May 1964 15 p ref
(Contract N156-43450)
(Rept.-6784-1533-V; AD-441267)

Test coupons coated with selected Viton A coating materials were submitted for evaluation in the rain-erosion-resistance tester. The abrasion resistance of Viton A coatings identical to those applied to the test coupons is changed little, if any, by exposure to temperatures of 450° and 500° F for periods of 15 hr. These coatings retained 80% to 90% of their original abrasion resistance after exposure for 200 hr in an Atlas twin-arc weatherometer. Four experimental silicon–nitrogen compounds were evaluated to provide information on the relationship between polymer structure and heat- and abrasion-resistant properties. Although none of these polymers was sufficiently resistant to abrasion to be of immediate interest, the exceptional heat resistance encourages further investigation. Two commercial silicon coating materials—Silastic Q 9-0090 and Q 92-009—were unsatisfactory erosion-resistant coatings because of poor abrasion resistance. Author

N64-27726 Union Carbide Corp., Cleveland, Ohio Linde Div.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID TANTALUM ELECTROLYTIC CAPACITORS Quarterly Progress Report, Jan. 1–Mar. 31, 1964
J. E. Riley [1964] 46 p ref
(Contract DA-36-039-AMC-03624(E))
(QPR-3; AD-601302)

Results are presented of the first 3 months of the 1-year engineering study for the production of high reliability 22μf, 50-volt solid tantalum electrolytic capacitors. The parametric data and reliability behavior are presented for all capacitor groups produced during the quarter. Some of these lots have been successfully graded, by accelerated life testing, to the target failure rate of 0.001% per one thousand hours. Additional physical and chemical data, and photomicrographs of the various vendor tantalum powders are given. Results are presented of experiments on anodic formation, MnO_2 impregnation, and reformation. A relationship between formation current density and finished component d.c. leakage is described. Experiments on constant power formation are discussed. Critical process variables in the MnO_2 impregnation process are identified. Author

N64-27730 SKF Industries, Inc., King of Prussia, Pa. Research Lab.
INFLUENCE OF LUBRICATION ON ENDURANCE OF ROLLING CONTACTS Progress Report No. 10, 22 Dec. 1963–22 Mar. 1964
E. F. Brady, S. C. Chou, J. Martin, J. Mc Cool, W. Schmidt et al [1964] 45 p refs
(Contract NOw-61-0716-c)
(AL64T037; AD-602643)

The process developed for preparing permanent-contact autoradiograms on metallic surfaces is described, and the results from autoradiograms obtained on ball sets tested in a Shell sliding four-ball machine are presented. Both wear and conductivity tests were made. A.W.

N64-27734 Stanford U., Calif.
THE MANUFACTURE OF THIN SHELLS BY THE ELECTROFORMING PROCESS Technical Report No. 6
R. L. Sendelbeck Apr. 1964 26 p refs
(Contracts Nonr-225(47); DA-44-177-AMC-115(T))
(SUDAER-185; AD-601494)

The work described has shown that by the electroforming process it is possible to accomplish the following: (1) manufacture thin-shelled shapes with large reentrant angles, and spherical shapes, to a high degree of accuracy; (2) manufacture thin-shelled cylinders and cones to a high degree of accuracy and with exact duplication of specimens; and (3) manufacture any specimen so that it requires no further finishing, thus eliminating stress concentrations from mechanically working the material. Author

N64-27776 Aircraft Armaments, Inc., Cockeysville, Md.
INVESTIGATION OF TELECARTRIDGE DISSEMINATION TECHNIQUES Final Comprehensive Report, 1 Jan. 1963–29 Feb. 1964
J. R. Herbert and R. C. Moyer Feb. 1964 55 p refs
(Contract DA-18-108-AMC-80(A))
(ER-3043C; AD-600949)

Progress is reported for the following work: (1) nozzle design for most efficient dissemination; (2) ballistic tests; (3) actual test firings and instrumentation at ACC test facilities for *bis*-2 ethythexyl-hydrogen phosphite and egg albumin–carbon tetrachloride; and (4) analysis of high-speed motion pictures. Author

N64-27778 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
QUALITY CONTROL MANUAL INSPECTION PROCEDURES FOR SILICON NPN DIFFUSED MESH, DEVICE TYPE XP-1714 (2N656)
15 Aug. 1963 174 p
(Contract DA-36-039-SC-86730)
(MP QRA 102; AD-602938)

The manual contains four sections that include discussions of product acceptance testing, packaging, data analysis, reliability engineering, organization, quality reports, flow diagrams, and test facility. A.W.

N64-27824 Virginia U., Charlottesville Research Labs. for the Engineering Sciences
RESEARCH INVESTIGATION OF MAGNETIC AND ELECTRIC FORCES FOR ROTATING SHAFT SUSPENSION Technical Quarterly Progress Report, Dec. 1963–Feb. 1964
M. G. Foster Mar. 1964 19 p
(Contract AF 33(657)-8352)
(EMI-3421-108-64U; AD-432482)

The results of 3 months of equipment redesign are presented. The outline of a magnetic-support bearing for a 1-hp system is proposed, and the electronic equipment necessary for driving it is described. Attempts to make an active radial support system are discussed. R.T.K.

N64-27846 General Electric Co., Lynchburg, Va. Command Systems Div.
MICROMINIATURE CRYSTAL UNITS CR-(XM-47) Fourth Quarterly Report, 1 Feb.–30 Apr. 1964
W. G. Stoddard [1964] 22 p
(Contract DA 36-039-AMC-02232(E))
(Rept.-4; AD-603029) OTS: $1.00

Modification of the header ceramic seal was necessary to prevent fracture. Ceramic thickness was increased to 0.030 in. so that the ceramic seal could withstand the 90° lead bend test without fracture. Ceramic diameter was reduced to 0.185 in. to accommodate more braze material between 52-alloy compression ring and ceramic. Two crystal blank designs at 15 mc were investigated. The partially contoured design had superior performance to a flat blank design. The effects on two types of conductive epoxy cement on crystal parameters were also investigated. Five electron-beam sealing experiments are described. Weld schedule optimization is being accomplished using cut-and-try techniques. The most significant problem in sealing is ceramic fracture due to use of improper weld schedules. Author

N64-27848 Lewis (E.B.) Co., Inc., East Hartford, Conn.
PRODUCTION ENGINEERING MEASURE, CRYSTAL UNIT CR-(XM-46) Quarterly Report, 1 Feb.–1 May, 1964
Robert P. Mc Comb [1964] 25 p
(Contract DA-36-039-SC-86737)
(QR-7; AD-603408) OTS: $2.00

Experience in fabricating CR-(XM-46)A/U units using cultured quartz has indicated that cultured quartz from several manufacturers should be evaluated. Not only did the units have exceptionally high equivalent resistance, but there was an extremely serious increase in resistance at the higher temperatures. In many cases the units became completely inoperative. The work done on natural quartz to improve the equivalent resistance level indicates that the maximum level as indicated in the device specification can, in general, be met. The work done at 70 mc/s shows that the design methods and techniques are adequate. Author

N64-27850 Texas Instruments, Inc., Dallas Semiconductor-Components Div.
PRODUCTION ENGINEERING MEASURES TO INCREASE TRANSISTOR RELIABILITY Final Engineering Report
Doyce R. Briggs [1964] 214p
(Contract DA-36-039-SC-86730)
(Rept.-03-64-45; AD-602940)

The crystal growing program has proven to be highly successful for making a better controlled grown junction crystal. This system also can be used on other devices. No material was found to be better than quartz as a crystal puller liner. Reciprocating and inside diameter silicon saws proved to be better than the outside diameter rotating disc saw. Cold welding was incorporated into the process and resulted in a minimum of outgassing during sealing. Use of cold welding permitted elimination of desiccant and bar coating. Process improvements in the fusing, drying, wire welding, and cleaning operations substantially increased device reliability. Improvements centered on base wire fusing ambients, silicon bar drying, base wire welding and annealing, bar etching and rinsing, and can and header cleanup. Author

N64-27856 Kaman Aircraft Corp., Bloomfield, Conn.
FEASIBILITY INVESTIGATION OF HARMONIC DRIVE SPEED REDUCERS FOR HELICOPTER APPLICATION
R. B. Bossler, Jr. Ft. Eustis, Va., Army Transportation Res. Command, May 1964 116 p refs
(Contract DA-44-177-TC-716)
(R-446; TRECOM-TR-64-12; AD-602018)

The purpose of this program is to evaluate the feasibility of harmonic drive transmissions as main or auxiliary speed reducers in Army aircraft. This report presents applicable helicopter and harmonic drive (H.D.) parameters, feasibility comparisons, and reports on engineering and design of a test unit; a boundary-layer lubrication investigation; and a test program to explore a known H.D. limitation for helicopter feasibility efficiency. Comaprison of H.D. and conventional transmissions is presented over a range from 250 HP to 4,000 HP to appropriate helicopter requirements. The H.D. shows advantages in reliability, maintenance, cost, noise, and weight. In general, these advantages increase with power. Power losses remain as a factor limiting, but not excluding, H. D. for helicopters. The H.D. is definitely feasible for auxiliary reducers as used in rescue hoists and actuators. Feasibility as a helicopter main speed reducer depends on tradeoffs. Author

N64-27862 General Electric Co., Syracuse, N.Y. Semiconductor Products Dept.
PRODUCTION ENGINEERING MEASURE: SILICON PLANAR EPITAXIAL TRANSISTOR, TYPE 2N2193 Final Report, 1 May 1962–28 Feb. 1964
A. S. Rugare [1964] 219 p
(Contract DA-36-039-SC-86727(E))
(AD-601889)

The results of investigations of the following operational problems are presented: window etching, collector etching, contact evaporation and alloying, boron diffusion, phosphorus diffusion, collector contact to the header, and interconnections. R.T.K.

18 MATERIALS, METALLIC

Includes cermets; mechanical and physical properties of alloys and metals; and metallurgy. *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 19 Materials, Nonmetallic; 33 Stresses and Loads; and 34 Structural Design.

N64-27023 Bell Aerosystems Co., Buffalo, N.Y.
ACTIVITIES OF BELL AEROSYSTEMS COMPANY WITH REFRACTORY MATERIALS
F. M. Anthony *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. II Nov. 1963 p 370–387 Previously published as N63-85363 (See N64-27020 19-01)

Investigations conducted on the suitability of presently available foil gage coated metal, for heat shield applications, and the results of these investigations are discussed. Test data are presented for coated Nb and Mo alloy panels and for Mo alloy riveted joints. Also, a recently initiated program to investigate coatings for superalloy foil gage components is outlined. I.v.L.

N64-27024 Martin Co., Denver, Colo.
RECENT DEVELOPMENTS AT MARTIN-DENVER IN THE REFRACTORY COMPOSITES AREA
R. L. Wells and K. R. Agricola *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. II Nov. 1963 p 388–400 ref (See N64-27020 19-01)

A heat-shield body panel of D-14 Nb alloy was subjected to the first cycle of a Pfaudler coating cycle. The outline of this cycle is (1) placement of the panel in a Cr-Al powder

pack, (2) 3-hr heat-up to 2,100° F, (3) 5 hr at 2,100° F, and (4) cool-down in the pack. Considerable cracking was observed in the panel upon removal from the retort after this cycle, and random areas of the panel were extremely brittle. A chemical analysis was made of the panel, and it was found that it had absorbed detrimental quantities of interstitials during the cycle. These interstitial contaminants were O_2, H_2, and N_2. The tensile and bend properties of the coated panel were then evaluated to determine the effect of contamination. The tensile and bend data obtained supported the theory that the detrimental contamination factor was the oxygen concentration. I.v.L.

N64-27025 American Machine and Foundry Co., Alexandria, Va.
ACTIVITY REPORT OF HIGH TEMPERATURE COATING AND MATERIAL PROGRAMS AT AMF
M. E. Browning and E. A. Schatz *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. II Nov. 1963 p 401–430 refs (See N64-27020 19-01)

A brief synopsis of work on high-temperature oxidation-resistant protective coatings for various metals is presented. The composite materials that have been examined for application to liquid-fuel rocket motors, thermal-control coatings, and structural materials are discussed. The results of thermal radiation measurements made with an integrating sphere reflectometer are reported. R.T.K.

N64-27026 Aeronautical Systems Div., Wright-Patterson AFB, Ohio
PROGRESS BRIEFING FOR REFRACTORY COMPOSITES WORKING GROUP MEETING, 12–14 MARCH 1963
J. C. Ingram, Jr. *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. II Nov. 1963 p 442–449 (See N64-27020 19-01)

A summary of research efforts in the following areas is presented: brazed honeycomb heat-shields and structural panels; solid-state diffusion-bonded honeycomb panels; hot frontal sections for superorbital reentry; refractory-metal-alloy structural mechanical fasteners; liquid-metal structural cooling; ceramic–metallic composite structures for superorbital reentry; meteoroid impact investigations; utilization of refractory nonmetallic materials—brittle structures; and metallic–ceramic composite structures. R.T.K.

N64-27028 National Academy of Sciences-National Research Council, Washington, D.C.
EVALUATION PROCEDURES FOR SCREENING COATED REFRACTORY METAL SHEET
J. J. Gangler *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. II Nov. 1963 p 468–482 (See N64-27020 19-01)

A set of procedures that can be uniformly used by large or small coating developers is defined. The procedures emphasize the oxidation protection a coating will give the substrate at high temperatures at one atmosphere air pressure. The effect of the coating process and coating on the bend transition temperature of alloys is discussed. The minimum tests to establish the reproducibility and reliability of a coating system are presented, and the studies to determine the effect of the coating process on the base metal are outlined. R.T.K.

N64-27030 Vitro Labs., West Orange, N.J.
DEVELOPMENT OF PROTECTIVE COATINGS FOR REFRACTORY ALLOYS
M. H. Ortner *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. II Nov. 1963 p 509–516 (See N64-27020 19-01)

An electrophoretic process for the application of oxidation-resistant coatings to refractory alloys is described. Data illustrating the coating uniformity of the process on a series of 1/4-20 TZC hex-head bolts are presented in tabular form. A photomicrograph of a typical $MoSi_2$-Ni-coated TZM threaded fastener is included. The fasteners, coated with $MoSi_2$-6%Ni, were oxidation tested in static air at 2,500° F, and yielded average lives of 24 hours for a 0.0015-in.-thick coating, to 40 hours for a 0.0025-in.-thick coating. The failure loads of the coated fasteners in a short-time tensile test at room temperature and at 2,000° F are presented. R.T.K.

N64-27067 IIT Research Inst., Chicago, Ill.
THE EFFECT OF PURITY ON GRAIN GROWTH IN ALUMINUM Technical Report Number 6
Paul Gordon and T. A. El-Bassyouni Jul. 1964 27 p refs (Grant DA-ARO-(D)-31-124-695)
(AROD-2205-6; AD-443949)

Grain growth data in zone-refined aluminum and in dilute alloys of copper with this aluminum were obtained. The amounts of copper added were from 4 to 400 atomic ppm. In both the unalloyed aluminum and in the alloys grain growth was characterized by a high value of n in the isothermal growth equation, $\delta^n = Kt$. The inadvertent presence of 1 atomic ppm iron in the alloys was more potent in slowing growth than the purposely added copper. Possible rationalizations of these observations and their general relevance to the theoretical use of grain growth data are discussed. Author

N64-27084 Boeing Co., Seattle, Wash.
EVALUATION OF FS-85 COLUMBIUM ALLOY (Cb-27% Ta-12%W-1%Zr)
R. G. Baggerly and R. T. Torgerson [1964] 29 p refs (D2-20239-1)

An evaluation of Fansteel FS-85 columbium alloy (Cb-27Ta-12W-1Zr) was conducted to establish its potential as a structural material for reentry vehicles. Properties that were investigated include tensile properties to 3,500° F, formability, ductile–brittle transition temperature, fusion welding, protective coating, and oxidation resistance. Testing was conducted using 0.030-in. sheet from one heat of material. The evaluation indicates FS-85 alloy has potentially useful strength in the temperature range of 2,000° F to 3,500° F. The alloy displayed good formability at room temperature, less than −320° F transition temperature, and good fusion weld strength and ductility. The oxidation resistance of Disil-coated FS-85 alloy is similar to that of other high-strength columbium alloys. FS-85 alloy is a promising second generation columbium alloy, having useful properties for structures of aerospace vehicles. Although the strength–weight properties from 2,000° to 3,000° F are somewhat lower than for other promising columbium alloys, the superior ductility of Disil-coated welds of FS-85 may be a significant factor in its consideration for certain applications. Author

N64-27085 Boeing Co., Seattle, Wash.
EVALUATION OF D-43 COLUMBIUM ALLOY (Cb-10W-1Zr-0.1C)
R. G. Baggerly and R. T. Torgerson [1964] 27 p refs (D2-20275-1)

The evaluation indicates D-43 is a heat treatable alloy with potentially useful strength in the temperature range of 2,000° F to 3,000° F. The alloy displayed good formability at room temperature, subzero transition temperature and good weldability with the tungsten-arc inert-gas process. The welds are characterized by good strength but marginal ductility in the as-welded condition. The oxidation resistance of Disil-coated D-43 is relatively poor at 2,700° F and 3,000° F compared to other high-strength columbium alloys. It is concluded that marginal weld ductility, poor oxidation resistance with the Disil coating, and questionable thermal stability are potential disadvantages to use of D-43 alloy and that these factors should be investigated further before this alloy is considered for structures of aerospace vehicles. Author

N64-27087 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
CORROSION AND PROTECTION OF METAL STRUCTURAL MATERIALS [KORROZIYA I ZASHCHITA KONSTRUKTSIONNYKH METALLICHESKIKH MATERIALOV]
Tomashova, N., ed. 20 Mar. 1964 357 p Transl. into ENGLISH of a Collection of Articles Moscow, Gos. Nauchn.-Tekhn. Izd. Mashinostr. Lit., 1961 p 5-260
(FTD-TT-63-672/1+2; AD-600784)

This collection is devoted to problems involving the corrosion of metallic structural materials in various corrosive media and under various conditions. New methods of corsion studies and tests are described, and the results of recent studies linked with the corrosion and protection of metallic materials and certain practical designs, as well as with the corrosion of certain new alloys, are cited in a number of articles. The data incorporated in the collection are of interest to scientific and production-engineering workers concerned with the problems of corrosion and the protection of metals. Author

N64-27147 Joint Publications Research Service, Washington, D.C.
SPECIAL STEELS AND ALLOYS
19 Jun. 1964 52 p refs Transl. into ENGLISH of 3 Articles from Spets. Stali i Splavy, Works of the Central Sci. Res. Inst. of Ferrous Met. (Moscow), no. 35, 1963 p 11-23, 31-45, 69-77
(JPRS-25163; OTS-64-31518) OTS: $1.50

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N64-27148 Joint Publications Research Service, Washington, D.C.
HIGH-STRENGTH, PRECIPITATION-HARDENING, LOW-MAGNETIC Fe-Cr-Ni ALLOYS
E. I. Belikova and O. I. Putimtseva *In its* Spec. Steels and Alloys 19 Jun. 1964 p 1-18 refs (See N64-27147 19-18) OTS: $1.50

The dispersion-hardening, low magnetic alloy EI787 (Cr-Ni-35W-Ti-Al) and the steel EI786 (O-Cr-14Ni-28W-3Ti-3Al-B) were satisfactorily forged into billets and discs, rolled into rods and sheets, and were wire drawn. The mechanical properties and the magnetic permeability of the EI786 steel and EI787 alloy were determined. R.T.K.

N64-27149 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF STEELS FOR GAS TURBINE PARTS
Yu. V. Latyshov *In its* Spec. Steels and Alloys 19 Jun. 1964 p 19-37 refs (See N64-27147 19-18) OTS: $1.50

The steels studied belong to the 15-35 type (15% Cr and 35% Ni) with the exception of two melts of the 15-25 steels (No. 9 & 10). Low carbon Cr-Ni steels of the 15-35 type can be used for long-term service. The properties of such steels are quite stable. It is advisable to alloy the low carbon 15-35 steels with tungsten, molybdenum, and titanium to provide the required combination of high heat resistance and long-term plasticity at 650° C (15-35W-Mo-Ti steel). The heat resistance properties of steels whose hardening takes place as the result of the intermetallic phase are superior to those steels in which carbide hardening is predominant. R.T.K.

N64-27150 Joint Publications Research Service, Washington, D.C.
EFFECT OF MOLYBDENUM ON THE PROPERTIES OF AUSTENITIC Cr-Ni-Cu STEELS
Ye. V. Zotova *In its* Spec. Steels and Alloys 19 Jun. 1964 p 38-49 (See N64-27147 19-18) OTS: $1.50

A study was made of the effect of molybdenum (from 0% to 4%) on the basic properties of austenitic Cr-Ni-Cu steel of the 18CR-28Ni-3Cu, 23Cr-23Ni-3Cu, and 23Cr-28Ni-3Cu types. The molybdenum slightly increases the strength and decreases the plasticity of the steel; with an increase of the molybdenum content the impact strength of the steel is reduced, particularly the steel with 23%Cr. The molybdenum sharply increases the resistance of the steel to general corrosion in 5% to 70% sulfuric acid and has no effect in 80% and 90% sulfuric acid. Author

N64-27187 Gt. Brit. Dept. of Scientific and Industrial Research, Glasgow National Engineering Lab.
THE MECHANICAL PROPERTIES AND DEFORMATION CHARACTERISTICS OF METALS AND ALLOYS UNDER PRESSURE
H. Ll. D. Pugh Mar. 1964 84 p refs
(NEL-142)

New apparatus for tensile tests under pressure in which the neck is photographed directly enables a continual record of true strain to be obtained. With zinc, a sharp transition from brittle to ductile behavior occurred at a critical pressure. With all the materials tested, the stress and strain at the maximum load point and the shape of the stress-strain curve were unaffected by pressure. The fracture stress of cast iron was dependent on volumetric stress and could be represented by a maximum principal stress criterion; that of copper and mild steel also conformed to this criterion, the critical value being independent of volumetric stress. Apparatus used for hydrostatic extrusion and for the differential-pressure extrusion of brittle materials is described. Difficult metals were successfully extruded. An empirical relation between extrusion pressure, extrusion ratio, and billet hardness is given. Heavy surface shearing is avoided by hydrostatic extrusion through a small-angle die, which enables tool steel to be cold extruded without cracking. Very long billets, in the form of spirals or coils, can be extruded by this method, giving a wire-producing process free from the limitations of reduction of area per pass imposed by the strength of the product. Author

N64-27230* National Aeronautics and Space Administration, Washington, D.C.
BRAZING AND WELDING OF BERYLLIUM [HARTLOTEN UND SCHWEISSEN VON BERYLLIUM]
H. Weik Jul. 1964 29 p refs Transl. into ENGLISH from Metallwiss. und Tech., v. 18, no. 3, 1964 p 235-243
(NASA-TT-F-9021)

Recent developmental work in the areas of beryllium metallurgy is described. The state of technology of brazing and welding of beryllium is examined. Suitable joints have been obtained as follows: in the case of rods, by butt brazing in a vacuum and by resistance butt brazing at current intensities above 80,000 A/cm^2; and in the case of sheets, by spot brazing and welding and by arc welding. Ultrasonic welding processes for the welding of beryllium sheets to each other as well as to other metals are also described. R.T.K.

N64-27265 Joint Publications Research Service, Washington, D.C.
ALUMINUM ALLOYS
I. N. Fridlyander, ed. 29 Jul. 1964 474 p refs Transl. into ENGLISH of the book "Alyuminiyevyye Splavy", no. 3 Moscow, 1963 p 1-404
(JPRS-25642; TT-64-31914) OTS: $7.75

Presented are the results of certain scientific and research studies conducted in the search for the optimum compositions of aluminum alloy systems—Al-Mg, Al-Mg-Si, and Al-Zn-Mg—the development of the methods of producing the mill products from the new and standard alloys, and thorough testing of these alloys and processes in industry. Special attention is given to studies of the forging parameters and the fusion welding of the alloys, questions of heat treatment, dimensional changes in the alloys, diffusion of the alloying elements in the aluminum, and the crystallization of the ingot and the appearance of defects in the ingot. A.L.B.

N64-27278* Hydronautics, Inc., Laurel, Md.
CAVITATION DAMAGE IN LIQUID METALS Progress Report No. 235-6, 2 Jul.-2 Oct. 1963
H. Preiser, C. Couchman, and A. Thiruvengadam [1963] 37 p refs
(Contract NASr-105)
(NASA-CR-56843) OTS: $3.60

Detailed shop drawings were completed and fabrication was begun on a vacuum dry box for cavitation damage testing of refractory metals at high temperatures. All associated auxiliary systems, such as cooling, cover gas, sodium storage and charging, and electrical instrumentation, were designed. Further experiments were performed to determine the effect of specimen diameter on damage rate in the magnetostriction device. A series of experiments were performed on commercially pure iron and titanium to determine the effects of time, amplitude, and temperature on the rate of cavitation damage in liquid sodium. Some preliminary fatigue tests were conducted with a 1020 steel specimen in liquid sodium at 300° F. The testing method is described in detail. R.T.K.

N64-27289* Advanced Metals Research Corp., Somerville, Mass.
PROPERTIES OF NON-STOICHIOMETRIC METALLIC CARBIDES Final Report
J. T. Norton and R. K. Lewis 6 Apr. 1964 42 p refs
(Contract NASw-663)
(NASA-CR-58046) OTS: $4.60 ph

A study of the carbides of the group IV transition metals (Ti, Zr, Hf) has been made with primary emphasis on the Ti-C system. Specimens of high purity were prepared by powder metallurgy techniques over the nonstoichiometric range $TiC_{0.50}$ to $TiC_{0.95}$. Specimens of sufficiently low oxygen content and low free carbon were obtained only in the range $TiC_{0.75}$ to $TiC_{0.92}$. The following properties which could be measured on powders or nondense specimens were determined as a function of carbon content: lattice parameter, specific gravity, thermal expansion, and thermoelectric power. The electronic structure of the nonstoichiometric carbides is discussed on the basis of the observed properties. Author

N64-27298* Southern Research Inst., Birmingham, Ala.
THE THERMAL CONDUCTIVITY OF THERMOCOUPLE GRADE CONSTANTAN ROD Final Report
John M. Carroll 23 Jun. 1964 25 p refs
(Contract NAS8-5196)
(NASA-CR-56932; Rept.-6833-1481-XXIII) OTS: $2.60 ph

Determination was made of the thermal conductivity of thermocouple grade constantan rod from 500° F (260° C) to the melting point of the material. The specimen material was obtained from 1-inch-diameter rod, supplied by NASA in two pieces approximately 8 inches long. Three specimens 1 inch long were machined for radial inflow apparatus and two for comparative rod apparatus. The thermal conductivity was determined in the comparative rod by comparing temperature drop through the specimen to that in a reference material of known conductivity; it was determined in the radial inflow apparatus from 500° to 1,650° F in a direct measurement technique. Conductivity increased almost linearly from 190 Btu/hr/ft^2/° F/in. at 500° F to approximately 370 Btu/hr/ft^2/° F/in. at 1,700° F. Evaluations made using both apparatus were in good agreement. A.W.

N64-27336 Ryan Aeronautical Co., San Diego, Calif.
ENGINEERING PROPERTIES OF ALUMINUM ALLOY 2219
R. S. Adams and D. S. Adams 3 Jun. 1963 48 p
(Rept.-63B049)

Presented are a group of tables giving the material description, test condition, weld condition, and base material of aluminum alloy 2219. G.D.B.

N64-27341 Iowa State U. of Science and Tech., Ames Ames Lab.
A STUDY OF THE YTTRIUM-OXYGEN SYSTEM
Robert Clark Tucker, Jr. and O. N. Carlson Feb. 1964 55 p refs
(Contract W-7405-ENG-82)
(IS-812) OTS: $1.25

An equilibrium phase diagram was proposed for the yttrium-oxygen system. Evidence of a eutectoid transformation at 1,180° C was obtained from the examination of microstructures and supported by differential thermal analysis, resistivity, and X-ray diffraction data. The solid solubility of oxygen in α yttrium was found to increase from less than 1,000 ppm at 600° C to 3.3 w/o at the eutectoid temperature. The intersection of the β solvus with the eutectoid horizontal established the eutectoid composition as 3.8 w/o oxygen. The β solvus increased from this to 7.3 w/o oxygen at 1,560° C. The $\alpha/\alpha+\beta$ boundary was tentatively determined from resistivity data. The solidus exhibited a maximum at about 5.5 w/o oxygen and 1,670° C and a eutectic horizontal at 1,560° C.

The eutectic composition was estimated at 9.7 w/o oxygen from the intersection of the liquidus and the eutectic horizontal. This estimate was supported by microstructural evidence. Author

N64-27348 Wien U. (Austria) Physikalisches Inst.
INVESTIGATION OF THE EFFECTS OF ULTRASONICS ON THE DEFORMATION CHARACTERISTICS OF METALS Interim Report, 1 Feb.–30 Apr. 1964
[1964] 13 p refs
(Contract N-62558-3436)
(IR-4)

In this report, further results regarding the irradiation influence on hardening by irradiation prior to the static tensile test, and on the softening effects during this process are described. There were new results on the influence on recovery of prehardened crystals by superimposed irradiation. The ultrasonic influence on diffusion processes was studied by investigations on the change of microhardness of impure metal samples during the incubation time of recrystallization, the observation of the change in hardness, and the behavior during the static tensile test of fully annealed zinc samples. Author

N64-27370 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
INTERIM REPORT ON THE EFFECT OF CRACK SHAPE ON FRACTURE TOUGHNESS
D. L. Corn and W. V. Mixon 27 Apr. 1964 31 p refs
(SM-44671)

The purpose of this program is to determine the effect of crack eccentricity upon fracture toughness. Fracture toughness tests, using partial thickness crack (PTC) coupons, were performed on two heats and three thicknesses of the 18Ni-9Co-5Mo (300 psi) maraging steel. In addition, data on tempered 4340 steel and aged Ti-6Al-6V-2Sn were taken from the literature and analyzed. Author

N64-27375 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
MECHANICAL PROPERTIES TESTS OF WELDED A-356-T6 ALUMINUM ALLOY
E. N. Bossing 20 Apr. 1964 10 p refs
(SM-45949)

Tests of welded areas in heavily chilled A-356-T6 aluminum alloy were conducted to determine feasibility of welding foundry defects in the gimbal thrust casting, P/N 1A74158. The results showed a mechanical property level commensurate with the retained magnesium content and the soundness of the weld deposit. All sound welds, when heat treated in the same manner as the gimbal thrust casting, met the minimum mechanical properties specified for critical areas on the design drawing. Author

N64-27393* Franklin Inst., Philadelphia, Pa. Research and Development Labs.
THE EFFECT OF NUCLEATION OF SURFACE SLIP ON THE FLOW AND FRACTURE OF BERYLLIUM Quarterly Progress Report, Jan. 22–Apr. 21, 1964
J. Breedis, A. Lawley, and J. Zeiger [1964] 20 p ref
(Contract NASR-145)
(NASA-CR-56314; Q-B2028-6) OTS: $1.60

The deformation of high-purity beryllium single crystals was examined in tension and during fatigue in reverse bending and cyclic compression. The single crystals were orientated for slip in one direction on the basal plane. Findings are reported from single crystals with basal plane inclined to the tension axis by 45 degrees, and deformed in tension and in two modes of fatigue—low-frequency cyclic compression, and high-frequency reverse bending. N.E.A.

N64-27419 Pratt and Whitney Aircraft, Middletown, Conn.
OBSERVATIONS CONCERNING THE INTERDIFFUSION OF Cb-1 Zr ALLOY WITH TYPE 316 STAINLESS STEEL
A. V. Manzione, F. J. Huegel, and D. E. Fornwalt 6 Sep. 1963 26 p refs Presented at the 12th Ann. Conf. on Appl. of X-ray Anal., Denver, Colo., Aug. 1963
(Contract AT(30-1)-2789)
(CNLM-5232)

Optical and electron metallographic, X-ray diffraction, and electron microbeam probe studies of the interdiffusion of Cb-1Zr alloy with type 316 stainless steel are reported. Co-extruded Cb-1Zr alloy-type 316 stainless steel diffusion couples were heat treated at temperatures of 732°, 871°, 982°, and 1,093° C for time periods of 115, 400, 900, and 1,400 hours. In no case was appreciable diffusion observed in specimens heat treated at 732° C for time periods chosen. Diffusion zones based on the systems iron–columbium and columbium–nickel–iron were observed in varying degrees in all other specimens. An activation energy for the rate controlling process in the growth of the diffusion layers is reported. The growth rates of the observed zones were retarded when these data were compared with data reported by other investigators for the interdiffusion of unalloyed columbium-type 316 stainless steel diffusion couples. Author

N64-27441 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
TUNGSTEN BASE ALLOYS HOT PRESSED FROM ELEMENTAL POWDERS
J. E. White 18 Jun. 1964 21 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-91; TDR-269(4240-10)-13; AD-603301)

The consolidation of refractory metal alloys (80W-10Mo-10Cb and 68W-20Ta-12Mo) from elemental powders of W, Ta, Mo, and Cb by mechanical mixing and hot pressing above 2,100° C has been encouraging. A study of compositional uniformity by electron microprobe analysis revealed that the most critical factor in promoting a homogeneous alloy is the starting particle size. Rather uniform composition can be obtained in the hot-pressed condition when all constituent powders are finer than 5μ. Electron beam melting of these alloys resulted in larger concentration gradients than those obtained by solid-state consolidation due to solidification segregation. Cold pressing and sintering resulted in homogeneity equal to the hot-pressed material; however, relative density was less than 85% after vacuum sintering up to 2,800° C, compared to better than 97% in the hot-pressed condition. The high-temperature stabilities as indicated by grain growth and hardness measurements are treated. Relative diffusion rates of the alloying elements that control ultimate uniformity are also revealed from the experimental data. Author

N64-27460 Minnesota U., Minneapolis
CYCLIC PLASTICITY EFFECTS IN INTERMEDIATE AND LOW CYCLE FATIGUE Technical Documentary Report, Jun. 1958–Dec. 1963

A. A. Blatherwick and Donald F. Mowbray Wright-Patterson AFB, Ohio. AF Mater. Lab., May 1964 55 p refs
(Contract AF 33(657)-7453)
(ML-TDR-64-120; AD-603206) OTS: $3.00

The cyclic stress–strain behavior of two different materials was observed in the low and intermediate cycle fatigue range. SAE 4130 steel, which softens under fatigue stressing, was subjected to reversed-flexure fatigue, and the moment-strain behavior was observed. Rotating bending tests were used to determine the cyclic stress–strain relationships as a function of the number of imposed cycles. Using these relationships, calculated moment-strain patterns for reversed-flexure were obtained for comparison with the observed experimental results. Pure copper in an annealed condition was the second material investigated. This material hardens under fatigue stressing. Reversed flexure tests were performed on this material, also, but in this case axial stress tests were used to determine the cyclic stress–strain properties. Again, predicted moment-strain trends, based on calculations using the axial-stress data, are compared with the experimental reversed-flexure results. The implications of this variable cyclic stress–strain behavior are examined. It is concluded that conventional S–N diagrams are not appropriate in the low and intermediate cycle range for tests conducted under constant moment or strain amplitudes. Author

N64-27461 Illinois U., Urbana
EQUILIBRIUM SOLUTIONS OF NITROGEN IN COLUMBIUM-BASE ALLOYS Technical Documentary Report, 15 Mar. 1963–15 Mar. 1964
E. de Lamotte, Y. C. Huang, and C. J. Altstetter Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1964 23 p refs
(Contract AF 33(657)-10626)
(ML-TDR-64-134; AD-602829) OTS: $2.00

Thermodynamic and mechanical properties of columbium–nitrogen and columbium–zirconium–nitrogen alloys were determined. The partial pressure of nitrogen in equilibrium with single-phase and two-phase alloys of various binary and ternary compositions was determined as a function of temperature for temperatures between 1,500° and 2,100° C. Heat of solution of nitrogen, heat of formation of Cb_2N, and heat of solution of Cb_2N values were determined for pure columbium and columbium with 0.86 wt % Zr. Internal friction and hardness were measured for several alloys quenched from above 1,500° C. For the radiation quench used, solid solutions with 0.075 wt % nitrogen and over could not be retained without precipitation. For the coarse-grained specimens hardness increased from 107 KHN for the pure columbium to 178 KHN for a two-phase alloy containing 0.68 wt % nitrogen. Author

N64-27467 Case Inst. of Tech., Cleveland, Ohio Research Labs.
SOLUTE INDUCED EMBRITTLEMENT IN STEEL AND SEVERAL FACE-CENTERED CUBIC ALLOYS
W. M. Cain, C. C. Koch, J. L. Mihelich, and A. R. Troiano Wright-Patterson AFB, Ohio, ARL, Jun. 1964 137 p refs
(Contract AF 33(616)-6419)
(ARL-64-101; AD-603315) OTS: $2.75

This report, which describes substitutional and interstitial induced embrittlement, is divided into discussions of (1) hydrogen embrittlement and plastic flow in a face-centered cubic nickel alloy, (2) spontaneous strain-aging embrittlement, and (3) the effect of microstructure and strength level on hydrogen-induced delayed failure. G.D.B.

N64-27476 Thompson Ramo Wooldridge Inc., Cleveland, Ohio
ADVANCEMENT OF HIGH TEMPERATURE PROTECTIVE COATINGS FOR COLUMBIUM ALLOYS (II) Technical Documentary Report, Mar. 1, 1963–Mar. 1, 1964
D. B. Warmuth, J. D. Gadd, and R. A. Jefferey Wright-Patterson AFB, Ohio, AF Mater. Lab., Apr. 1964 210 p refs
(Contract AF 33(657)-7396)
(ASD-TDR-62-934, Pt. II; TWR-ER-6061; AD-602129)

In a process optimization study the most protective Cr-Ti-Si coatings for cyclic oxidation in air at 1,800°, 2,500°, and 2,700° F were formed utilizing the following process conditions. The Cr-Ti alloy layer was deposited in 8 hours at 2,300° F in either a 50Cr-50Ti or a 60Cr-40Ti prealloyed powder pack. A system pressure of 1.5 mm was employed for the laboratory scale furnace and 10^{-2} mm for the pilot scale furnace. Siliconizing for 6 hours at 2,100° F at a system pressure of 10^{-2} mm was considered optimum for both furnace sizes. In a reproducibility and reliability study a statistical analysis was conducted to determine the oxidation protective reliability of the Cr-Ti-Si coating on B-66 and D-43 alloys at 2,000°, 2,500°, and 2,700° F. An investigation to evaluate a completely vapor phase process for silicon deposition was conducted employing a gas flow process. Coatings potentially equal to those deposited in the vacuum pack process were formed by this technique. Extensive testing of the Cr-Ti-Si coating at pressures as low as 10^{-2} mm and temperatures to 2,600° F was accomplished. The Cr-Ti-Si coating prevented visible columbium oxide growth for low pressure exposures up to 4 hours in duration. The relationship of joint fabrication and coating process procedures was investigated relative to cyclic oxidation life. Author

N64-27509* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
REACTIVITY OF TITANIUM WITH OXYGEN
W. A. Riehl, C. F. Key, and J. B. Gayle Washington, NASA, Dec. 1963 124 p refs
(NASA-TR-R-180) OTS: $2.75

The reactivity of titanium with oxygen was studied by several test methods and under a variety of conditions associated with space vehicles. Titanium is highly sensitive to impact in contact with lox, and this method was used to study the effects of surface treatments, coatings, and numerous other factors upon the reactivity. The comparative reactivities of titanium, aluminum, and stainless steel alloys with oxygen were investigated by impact, shock, puncture, and spark sensitivity testing. Punctures resulting from bullets, darts, pins, or artificial meteoroids usually caused explosions. Coatings that reduced titanium reactivity in impact or shock tests were not beneficial under puncture conditions. Aluminum and stainless steel failed to react on impact or puncture. The shock stimuli produced by small detonator caps alone were sufficient to initiate explosive reaction of titanium in contact with oxygen. An extremely heavy shock was necessary to cause aluminum to react under the same test conditions, and stainless steel did not react under the most drastic shock conditions employed. The titanium–oxygen combination is considerably more susceptible to spark initiation than aluminum–oxygen. A comparatively high energy spark was necessary for reaction of 0.010-in-thick sheets of titanium with oxygen. Under the particular test conditions used, titanium was insensitive to reaction with oxygen when subjected to vibration, pressure cycling, or to rupture with pressurization of thin-walled tanks containing lox.
Author

N64-27516 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EFFECT OF HYDROGEN CONTENT ON THE MECHANICAL PROPERTIES OF Ti-6Al-4V BAR AT −423°F
A. R. Burge and S. M. Weiman 15 Apr. 1964 18 p refs
(SM-44661)

The effect of hydrogen content on the mechanical properties of Ti-6Al-4V bar at −423° F was investigated. Smooth and notched tensile strength at hydrogen contents of 20, 100, and 200 ppm were determined. The notched tensile strength was determined at three K_t levels. The K_t levels were fixed by varying the root radius of circumferentially notched specimens. The results show a statistically significant interaction between notch sharpness and hydrogen content. A dull notch increased the load-carrying capacity of the specimens independent of hydrogen content, whereas the load-carrying capacity of sharp notched specimens decreased slightly with increasing hydrogen content. Author

N64-27541 Aerospace Corp., El Segundo, Calif. Materials Sciences Lab.
NON-METALLIC MATERIALS FOR HIGH TEMPERATURE STRUCTURAL APPLICATIONS
E. G. Kendall and J. D. Mc Clelland 22 Jul. 1964 42 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-10; TDR-269(4240-10)-9; AD-603239) OTS: $3.50

The urgent need for high-temperature aerospace materials is hastening the development of the refractory nonmetallics, including the carbides, graphites, oxides, borides, and beryllides. These materials are discussed with emphasis on high-temperature structural applications. A detailed compilation of physical and mechanical property data is presented, aerospace applications described, limitations of the materials reviewed, and promising areas of research outlined. These include (1) the carbide-graphite eutectics for intrinsic thermal shock resistance, (2) the prestressing of oxides for minimizing thermal shock cracking, and, (3) application of pyrolytic graphite at temperatures to 3,000° C. Author

N64-27544 Southwest Research Inst., San Antonio, Tex.
FUNDAMENTAL STUDIES OF CONTACT FATIGUE Progress Report No. 1, Apr. 24–Jul. 24, 1964
R. A. Burton and J. A. Russell 24 Jul. 1964 33 p refs
(Contract NOw-64-0460-d)
(RS-421; AD-443492)

Background material is outlined concerning previous work on contact fatigue phenomena. Experimental apparatus, system calibration, specimen preparation, and temperature measurement techniques are described, and statistical factors that govern the design of fatigue or endurance testing are discussed. An experimental program based upon these factors is presented in approximate chronological sequence. Author

N64-27574 IIT Research Inst., Chicago, Ill.
HEATING TIMES FOR SMALL ALUMINUM SAMPLES IN VARIOUS MEDIA Technical Report No. 8
Paul Gordon and T. A. El-Bassyouni Jul. 1964 4 p
(Grant DA-ARO(D)-31-124-G95)
(AROD-2205-6; AD-443929)

The results from a number of approximate measurements of the time taken by aluminum samples to reach a given temperature, from an initial room temperature, when quenched into hot organic liquids and molten metal, are presented. The samples used were two cylinders of aluminum—one was 1/2 in. long by 1/4 in. in diameter, and the other was 1/2 in. long by 1/8 in. in diameter. Their temperatures were measured with chromel–alumel thermocouples made of glass-coated .010-in.-diameter wire. A couple was inserted into a close-fitting, axial hole in each sample. Results for the following liquids are presented in tabular form: boiling bromobenzene, boiling dodecane, and molten Pb-Sn. P.V.E.

N64-27576 Advisory Group for Aeronautical Research and Development, Paris (France)
THE SCIENCE AND TECHNOLOGY OF TUNGSTEN, TANTALUM, MOLYBDENUM, NIOBIUM AND THEIR ALLOYS
N. E. Promisel, ed. (Bur. of Naval Weapons) Oxford, N.Y., Pergamon, 1964 529 p refs Presented at AGARD Conf. on Refractory Metals, Oslo-Blindern, Norway, 23–26 Jun. 1963 (AGARDograph-82; AD-442505) Pergamon: £7

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33. FORMING OF REFRACTORY METAL SHEET R. A. Perkins (Lockheed Missiles and Space Co., Palo Alto, Calif.) p 541–556 refs (See N64-27600 19-18)

34. JOINING OF REFRACTORY METALS A. G. Metcalfe (SOLAR) p 557–570 refs (See N64-27601 19-18)

35. FLOW TURNING (SHEAR FORMING) OF REFRACTORY METALS B. Natter and R. Machenschalk (Sinterstahl G.m.b.H.) p 571–580 (See N64-27602 19-18)

N64-27577 Birmingham U. (Gt. Brit.)

THE ELECTRONIC STRUCTURE AND ALLOYING CHARACTERISTICS OF THE EARLY TRANSITION METALS

A. D. Mc Quillan *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 51–61 refs (See N64-27576 19-18) Pergamon: £ 7

The electronic structure of the early transition metals is a complex problem unlikely to yield to a completely theoretical attack without the aid of a general picture built up by examination of the physical properties of alloys of the metals. The most promising physical properties are the temperature coefficient of electronic specific heat, the magnetic susceptibility, and possibly the critical temperature for superconductivity. Results so far obtained are reviewed. Technologically the most important alloying property of the metals is the ability of certain members of the group to take into solution large quantities of nonmetallic elements. The decrease in this ability to dissolve interstitial atoms with increasing electron–atom ratio of alloys is discussed and correlated with changes in physical properties. Author

N64-27578 General Telephone and Electronics Labs., Inc., Bayside, N.Y.

STRUCTURAL CONSIDERATIONS IN DEVELOPING REFRACTORY METAL ALLOYS

Leslie L. Seigle *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 63–93 refs (See N64-27576 19-18) Pergamon: £ 7

Available data concerning the effect of solutes on the strength and hardness of columbium, tantalum, molybdenum, and tungsten have been collected and reviewed. The interstitial solutes increase room-temperature hardness and strength of columbium and tantalum, and presumably tungsten and molybdenum, at a much more rapid rate than the substitutional solutes, but have no effect at elevated temperatures where dislocation locking by interstitials is absent. A correlation exists between the strengthening effect of substitutional solutes and group number in the periodic table, which suggests that the rate of strengthening of columbium, tantalum, molybdenum, and tungsten by substitutional solutes is related primarily to the increase in electron–atom ratio. Size effect plays a secondary role in solid solution strengthening. An important feature of the alloying behavior of the refractory metals is the possibility of interactions between interstitial and substitutional solutes, which are known, or presumed, to underlie several interesting types of anomalies in the variation of strength and hardness with solute content. Author

N64-27579 Liverpool U. (Gt. Brit.)
THE INTERACTION OF INTERSTITIAL SOLUTE AND SUBSTRUCTURE IN REFRACTORY METALS
D. Hull and W. S. Owen *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 95–109 refs (See N64-27576 19-18) Pergamon: £7
(Contract AF 33(657)-8424)

Discussed are substructure, interstitial solutes, discontinuous yield, strain-hardening, and brittle fracture. G.D.B.

N64-27580 Fansteel Metallurgical Corp., North Chicago, Ill.
THE TREND AND STATUS OF DEVELOPMENT OF REFRACTORY METAL ALLOYS
A. B. Michael and W. O. Gentry *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 111–129 refs (See N64-27576 19-18) Pergamon: £7

This paper reviews the status and trend of development of molybdenum, columbium, tantalum, and tungsten base alloys for elevated temperature applications. The importance of such factors as low temperature ductility, fabrication, and welding is considered. Author

N64-27581 Bell Aerosystems Co., Buffalo, N.Y.
RAPPORTEUR'S INTERPRETIVE STATEMENT
Wilfred H. Dukes *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 137–156 (See N64-27576 19-18) Pergamon: £7

Refractory metal applications for airframes and propulsion systems are discussed. Material property data requirements for airframe detail design, and propulsion system detail design are given. Refractory metal development is examined. G.D.B.

N64-27582 Max-Planck-Institut für Metallforschung, Stuttgart (W. Germany)
THE PHYSICAL PROPERTIES OF REFRACTORY METALS WITH REFERENCE TO OTHER ENGINEERING MATERIALS
E. Gebhardt and R. Rothenbacher *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 157–173 refs (See N64-27576 19-18) Pergamon: £7

This report is confined to those properties of the metals Nb, Ta, Mo, and W that are of particular importance in science and engineering. It covers the physical properties of the pure metals, the effects of alloyings on these metals, and the changes of properties that result from reactions between metals and gases. Author

N64-27583 Royal Armament Research and Development Establishment, Fort Halstead (Gt. Brit.)
THE EFFECTS OF TRACE ELEMENTS ON THE MECHANICAL PROPERTIES OF REFRACTORY METALS
A. J. Nicol-Smith and L. Northcott *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 175–190 refs (See N64-27576 19-18) Pergamon: £7

Trace elements are grouped into interstitial elements; substitutional solid solution impurities; substitutional solid solution additions; compounds, inclusions, precipitates and dispersoid systems; and major alloy additions. The latter are discussed from the point of view of their interaction with impurities and their influence in controlling the effects of impurities. The role of the body-centered cubic structure is considered, and the general effect of interstitial elements reacting with dislocations is discussed with some reference to room temperature mechanical properties, yield point phenomena, transition temperatures, strain aging, and the temperature dependence of tensile properties. Interstitial elements are reviewed in terms of their origin, pickup and removal, for example by deoxidation reactions. The various methods of nullifying the effects of such impurities are considered. Their influence on welding is discussed. The paper concludes with a statement of the major problems connected with the influence of trace elements on the mechanical properties, an assessment of the present lines of attack, and some suggestions for discussion. Author

N64-27584 National Physical Lab., Teddington (Gt. Brit.)
KNOWLEDGE OF THE THERMOCHEMISTRY OF REFRACTORY METALS AND ITS APPLICATION IN PREDICTION OF ENGINEERING STRUCTURES
O. Kubaschewski *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and their Alloys 1964 p 191–204 refs (See N64-27576 19-18) Pergamon: £7

The value of thermochemical knowledge and data for the assessment of chemical reactions of practical significance, such as production and refining of metals and metal-refractory interactions, is now undisputed, although much too little use is made in industry of the amount of information stored in thermochemical tables. The possibilities of "predicting metallurgical structures" from thermochemical knowledge are as yet more restricted, and the relations between thermochemical behavior and mechanical properties are largely unexplored. Probably the best use that can be made of thermochemical data at present for the problem in hand is the calculation of metallurgical equilibrium diagrams at service temperatures. The development of new alloys is generally based on the knowledge of the respective phase equilibria. However, phase boundaries can conveniently be determined only at temperatures where the equilibration rate is relatively fast, whereas alloys are frequently used in practice at lower temperatures. Author

N64-27585 Technische Hogeschool, Eindhoven (Netherlands)
DETERMINATION AND APPLICATION OF THERMOPHYSICAL PROPERTIES OF REFRACTORY METALS
G. D. Rieck *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 205–217 refs (See N64-27576 19-18) Pergamon: 7£

In this paper about the thermophysical properties of tungsten, tantalum, molybdenum and niobium, a number of properties, methods of determination and a reference to their application are discussed. The physical properties have in common the fact that heat or temperature plays an important role in the process of generating the relevant phenomena—diffusion under the influence of a temperature gradient, emissivity, heat capacity, thermal conduction, and liability to structural change when heated. Author

N64-27586 Central Technical Inst., TNO, Delft (Netherlands) Metaalinst
EFFECTS OF HIGH-ENERGY RATE-FORMING ON PROPERTIES OF REFRACTORY METALS
C. A. Verbraak *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 219–231 refs (See N64-27576 19-18) Pergamon: £7

The anisotropy of shock-wave deformation and the shock-wave deformation of molybdenum are described. G.D.B.

N64-27587 Oak Ridge National Lab., Tenn. Metals and Ceramics Div.

CORROSION MECHANISMS IN REFRACTORY METAL–ALKALI METAL SYSTEMS

J. R. Di Stefano and E. E. Hoffman *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 257–288 refs (See N64-27576 19-18) Pergamon: £ 7

The refractory metals and their alloys generally have shown sufficient corrosion resistance to be considered as structural materials for alkali metal reactors and for power conversion systems designed to operate at temperature in excess of 1,000° C. However, comparatively little quantitative compatibility information is available on specific refractory metal–alkali metal systems under a variety of test conditions. The limited data available indicate that niobium, tantalum, molybdenum, and tungsten are all less soluble in alkali metals than are constituents of conventional high-temperature alloys, such as iron, nickel, chromium, and cobalt. Molybdenum has been reported to have the lowest solubility. Interactions in refractory metal systems between two or more metals in contact with a common alkali metal have been limited to exposures involving high temperatures and long times. Phase diagrams of the metals under consideration can often be useful guides in predicting interactions of this type. No serious temperature-gradient mass-transfer effects have been detected in the limited number of nonisothermal tests of refractory metals in contact with flowing alkali metals. The most complete data are available for the molybdenum–lithium system. The most serious compatibility problems in refractory metal–alkali metal systems appear to occur as a result of impurities such as oxygen, hydrogen, nitrogen, and carbon in the system. Author

N64-27588 Ohio State U., Columbus

FUNDAMENTALS OF REFRACTORY METAL–GASEOUS ENVIRONMENT INTERACTION

Rudolph Speiser and G. R. St. Pierre *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 289–330 refs (See N64-27576 19-18) Pergamon: £ 7

This paper is a review of the present status of the fundamental aspects of the oxidation behavior of molybdenum, tungsten, niobium, and tantalum in gaseous atmospheres such as air, O_2–N_2, CO–CO_2, and H_2–H_2O mixtures at elevated temperatures. Comprehension of the mechanism of oxidation requires a full knowledge of the equilibria between the refractory metals and oxygen as well as the irreversible reaction of these metals with oxygen. The refractory metal–oxygen equilibria and the kinetics of oxidation of each refractory metal are discussed. Author

N64-27589 General Electric Co., Evendale, Ohio Flight Propulsion Lab. Dept.

EFFECTS OF ALLOYING AND COATING ON THE ELEVATED TEMPERATURE CORROSION RESISTANCE OF THE REFRACTORY METALS

M. A. Levinstein and S. T. Wlodek *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 331–356 refs (See N64-27576 19-18) Pergamon: £ 7

The high-melting refractory metals share a major common limitation of extremely high reactivity in oxidizing environments. Although semiprotective scales and parabolic or logarithmic rate laws are observed at very low temperatures, exposure above 500° to 700° C produces a linear rate of reaction, which at high temperatures or large gas velocities quickly consume the refractory metal. The high vapor pressure of MoO_3 (b.p. 1,400° C) and WO_3 (b.p. > 2,000° C), as well as the low melting points of the MoO_3–MoO_2 system (eutectic 777° C), preclude the possibility of forming a protective reaction product on molybdenum or tungsten. The inherent porous nature of WO_3 on tungsten also plays a role, and the same tendency to form powdery or cracked scales appears to be the main characteristic that renders the high melting point Cb_2O_5 or Ta_2O_5 scales on columbium and tantalum nonprotective. Alloying or coating concepts are discussed that will prevent the formation of MoO_3 and WO_3 on molybdenum and tungsten and either improve the plasticity of tantalum and niobium pentoxides or prevent their formation. Author

N64-27593 Boeing Co., Seattle, Wash.

OUTLINE EVALUATION OF FABRICABILITY OF REFRACTORY METALS

J. J. Stacy *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 405–420 refs (See N64-27576 19-18) Pergamon: £ 7

The purpose of this paper is to describe and discuss mechanical tests used to evaluate the fabricability of four refractory metals and their alloys, the metals being molybdenum, niobium, tantalum, and tungsten. It is based on types of tests rather than fabrication operations. In general, the coverage is limited to tests performed on sheet materials. The test is described and, insofar as possible, test data are presented and their significance discussed in relation to the forming operation. Author

N64-27594 Centre National de Recherches Metallurgiques, Liege (Belgium)

EVALUATION OF TEST METHODS FOR REFRACTORY METALS

D. Contsonradis *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 421–449 refs (See N64-27576 19-18) Pergamon: £ 7

The evaluation of the mechanical properties includes the determination of tensile, stress rupture, creep, shear, bearing, compression, fatigue, etc., strength. The present paper will deal in some detail with the tensile test as performed for the determination of tensile, creep, and stress–rupture strength. Author

N64-27595 Supercon Co., Houston, Tex.

CONSOLIDATION OF REFRACTORY METALS

J. Wong *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 465–476 refs (See N64-27576 19-18) Pergamon: £ 7

This is a review of past, present, and future developments in the consolidation of refractory metals. G.D.B.

N64-27596 Crucible Steel Co. of America, Midland, Pa. Midland Research Lab.

FLAT ROLLING OF REFRACTORY METALS

Paul S. Darby *In* Agard The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 477–484 refs (See N64-27576 19-18) Pergamon: £ 7 (Contracts AF 33(600)-39942; AF 33(600)-37939)

Refractory metal sheet is needed for its strength at high temperatures. It should be flat and ductile so that aerospace vehicles can be fabricated. The gage should be both thin and uniform to avoid unnecessary weight. The sheet should be wide enough to avoid seams or joints in the structure. The unusual

properties of refractory metal also present unusual processing problems. At the very high hot working temperatures all refractory metals oxidize rapidly, and many are embrittled. Suitable protection from the air during annealing and rolling is desirable and becomes essential at temperatures where oxidation is rapid or oxygen diffuses rapidly into the metal. The special problems of rolling refractory metals that are discussed are as follows: thin and wide dimensions, flat and uniform thickness, contamination-free processing, and ductility.

Author

N64-27597 Thompson Ramo Wooldridge, Inc., Canoga Park, Calif.

PRIMARY WORKING OF REFRACTORY METALS

A. S. Nemy *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 485–502 refs (See N64-27576 19-18) Pergamon : £7

(Contracts NOw-61-0874-C; AF 33(600)-41629; AF 33(657)-9141)

The primary working of the refractory metals has been reviewed in terms of current capability to produce mill products. The estimate has been made that there exists the mere beginnings of a commercial capability. Technology has been found lacking. A discussion of processing problems has been presented as well as a definition of the areas in which physical metallurgical data are needed. Author

N64-27598 Wyman-Gordon Co., Worcester, Mass.

SHAPE FORMING OF REFRACTORY METALS

M. E. Cieslicki *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 503–516 refs (See N64-27576 19-18) Pergamon: £7

The following processes are considered: closed die forging, ring rolling, shear forming, tube and shape extrusions, and centrifugal casting. While all of these are forming processes, the latter is considered separately. Centrifugal casting has been plagued by the difficulties attendant to high temperatures. The reactivity of the metals when molten is extremely high. Since no contaminants are known to be useful alloying elements, the methods are practically limited to cold mold techniques. The best casting methods are dependent on accurate temperature control. With refractory metals, there is inevitably a temperature gradient in the molten pool ranging from the melting point to the arc temperature. Sufficient heat must be introduced into the system in a short enough time to prevent the steady-state condition resulting from heat input and heat loss through radiation and conduction. In such a case, the primary aim is to get sufficient molten metal to cast rather than temperature control and uniformity. Pouring increases the radiation area, which results in a rapid temperature drop. This and the reaction of the metal with mold materials make good quality in terms of grain size control, definition of detail, and chemical purity most difficult to attain. Author

N64-27599 Battelle Memorial Inst., Columbus, Ohio Div of Metalworking Research

MACHINING OF REFRACTORY METALS

Francis W. Boulger *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 527–540 refs (See N64-27576 19-18) Pergamon: £7

Machining of refractory metals is discussed in terms of turning, drilling, and grinding. Problem areas and their solutions are given—metallurgical, electrical, and chemical. G.D.B.

N64-27600 Lockheed Missiles and Space Co., Palo Alto, Calif. Materials Science Lab.

FORMING OF REFRACTORY METAL SHEET

Roger A. Perkins *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 541–556 refs (See N64-27576 19-18) Pergamon: £7

The purpose of this paper is to delineate critical problems that may arise in the production forming of refractory metal sheet. The experience of principal manufacturers in the United States is reviewed to develop a more clear perspective of forming capabilities and limitations of commercial sheet materials. Only those parts and materials that have advanced into a preproduction phase where sufficient experience has been gained to define behavior are considered. Additional work in relation to metal forming that could be done to exploit more fully the outstanding potential of these materials and to encourage commercial use also is discussed. Author

N64-27601 SOLAR, San Diego, Calif. Research Labs.

JOINING OF REFRACTORY METALS

A. G. Metcalfe *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 557–570 refs (See N64-27576 19-18) Pergamon: £7

This paper deals with the joining of refractory metals for aeronautical applications. A major portion of the research effort in the United States is directed to solutions of the problems of applying these metals to high-speed aerospace vehicles, and this emphasis is reflected in this review. The joining of thin sheets and the ability of such joints to be provided with oxidation protection coatings are the major factors in the fabrication of structures for these vehicles. The application to powerplants generally requires thicker sections to be joined, and no coating may be required as in the nuclear rocket or in the nozzle throat of a chemical rocket. Author

N64-27602 Sinterstahl G.M.B.H., Fussen (W. Germany)

FLOW TURNING (SHEAR FORMING) OF REFRACTORY METALS

Bernd Natter and Rudolf Machenschalk *In* AGARD The Sci. and Technol. of Tungsten, Tantalum, Molybdenum, Niobium and Their Alloys 1964 p 571–580 (See N64-27576 19-18) Pergamon: £7

Spinning, deep drawing, and flow turning are aspects of shear forming discussed. G.D.B.

N64-27680 New England Materials Lab., Inc., Medford, Mass.

HIGH TEMPERATURE DEFORMATION AND FRACTURE BEHAVIOR OF METALS UNDER HIGH STRAIN RATE CONDITIONS Progress Report, 1 Jan.–1 Mar. 1964

J. M. Dhosi, R. Widmer, and N. J. Grant Apr. 1964 8 p

(Contract NOw-63-0502-C)

(PR-5; AD-600903)

Work was continued on evaluation of the high-strain-rate deformation behavior of cast Udimet 700, hot-pressed beryllium, and arc-melted tungsten. The work is aimed at determining optimum hot-working parameters of hard to work materials, with special emphasis on the as-cast condition. The results show that this can be achieved by testing ingot material at various strain rates, stresses, and temperatures. Samples were taken from various critical ingot areas, and therefore, from a different specimen axis. G.D.B.

N64-27685 Brown U., Providence, R.I.

A GENERAL METHOD FOR CALCULATING ELECTRON DIFFRACTION PATTERNS CONTAINING TWIN REFLECTIONS

E. S. Meiran and M. H. Richman (Fairchild Semiconductor Corp.) May 1964 7 p ref
(Sponsored by ARPA)
(ARPA-E7; AD-441383)

A general analytical method is presented that is capable of predicting and indexing electron diffraction patterns from twinned regions of cubic crystals. This method may be used for any cubic system and any twin plane. Calculation of all twin spots, including those superimposed on matrix spots, is made possible by this method. Author

N64-27691 Experimental Inst. of Light Metals, Milan (Italy)
RESISTOMETRIC INVESTIGATION OF THE RECOVERY OF DILUTED Al-Mg ALLOYS COLD-WORKED AT LIQUID NITROGEN TEMPERATURE Final Report, 1 Jan.–31 Dec. 1963
S. Ceresara and T. Federighi 30 Jan. 1964 43 p refs
(Contract DA-91-591-EUC-2768)
(Rept.-13.178/6401.105; AD-601654)

A set of diluted Al-Mg alloys, with a Mg content varying from 0 (99.995% Al) to 1.48 at. %, was cold-worked by compression at liquid-nitrogen temperature, and the recovery of the electrical resistivity was investigated in the temperature range from −190° to 340° C. Four principal recovery stages, conventionally indicated as H-1, H-2, H-3, and H-4, were found during the isochronal annealing in pure Al as well as in the alloys. The temperature ranges of each stage were determined and found to be roughly independent of the Mg content. The principal results obtained from the isochronal and isothermal annealing are summarized. R.T.K.

N64-27698 Frankford Arsenal, Philadelphia, Pa.
POINT DEFECT CONFIGURATIONS IN IRRADIATED IRON-CARBON ALLOYS
R. A. Johnson and A. C. Damask Apr. 1964 7 p refs
(A64-2; AD-440910)

A study of the binding energy of a carbon atom to various point defects in iron was made with the aid of a computer. A crystal of 530 iron atoms represented by two-body forces was the host structure for a carbon atom with an iron–carbon two-body potential. The computer solves the classical force equations to minimize the energy of the crystal for the various configurations sought. With a binding energy for the carbon atom to a vacancy of 0.41 ev, given by experiments, the carbon atom attaches itself inside the vacancy to five iron atoms on one of the sides of the vacancy. The carbon atom is calculated to be bound to the split iron interstitial with 0.5 ev and to a second iron interstitial with 1.0 ev. None of these defect complexes should contribute much to internal friction by stress-induced reorientation. The sequence of defect migration and trapping following low temperature irradiation is discussed on the basis of these calculations. Author

N64-27699 Minneapolis-Honeywell Regulator Co., Hopkins, Minn. Honeywell Research Center
THE MECHANICAL AND MICROMECHANICAL PROPERTIES OF BORON Interim Report No. II, 1 Mar.–30 Apr. 1964
J. A. Sartell and C. H. Li 18 May 1964 18 p refs
(Contract NOw-64-0159F)
(HR-64-266; AD-601042)

An analysis of the fracture of polycrystalline boron showed that fracture propagation, as well as the state of stress, is affected by microstructure. In the areas of tensile stress, fracture was conchoidal while in areas under compression a transaction to an imperfect form of cleavage sometimes occurs. Twin boundaries, grain boundaries, and grain orientation can influence the progress of a crack. Author

N64-27710 Massachusetts Inst. of Tech., Cambridge
MAGNETIC STUDIES OF IRRADIATED HEMATITE CRYSTALS Annual Technical Report
Robert E. Ogilvie 22 Jul. 1963 15 p refs
(Contract Nonr-1841(84))
(AD-412429)

A natural crystal of hematite was ground into the form of a sphere about 0.16 inches in diameter. Magnetic measurements by the Curie method were made before and after irradiation. The values of saturation moment, remanence and coercive force, before and after irradiation, are summarized in tabular form. It is clear that lattice defects are a possible source of ferromagnetism in hematite in both high- and low-temperature antiferromagnetic structures. Attribution of magnetic anomalies and diffuse neutron scattering in FeO has been made to superparamagnetic regions containing iron atoms in tetragonal sites. A.W.

N64-27723 Battelle Memorial Inst., Columbus, Ohio Defense Metals Information Center
OBSERVATIONS ON DELAYED CRACKING IN WELDED STRUCTURES OF UNALLOYED TITANIUM SHEET
R. H. Ernst, D. N. Williams, and H. R. Ogden 29 Apr. 1964 10 p refs
(Contract AF 33(615)-1121)
(DMIC-MEMO-191; AD-602478)

A brief study of delayed fracture in a seam-welded titanium panel is summarized. Examination of the fracture surface with electron microscopy showed that the material cleaved, failing in a brittle manner. Although the nature of the embrittlement was not clearly defined, titanium hydride phase was suspected as a prime contributor to failure. Even though the hydrogen content of the titanium was only 65 ppm, hydride embrittlement was thought to have occurred from precipitation of hydride platelets on crystal planes oriented normal to welding stresses. Other work, briefly discussed, has confirmed that hydride platelets in titanium can be oriented by stress and that tensile ductility of Zircaloy (which behaves similarly with respect to hydrogen) depends upon the hydride orientation. Author

N64-27761 Joint Publications Research Service, Washington, D.C.
MAGNETOMETRY FOR STUDYING RARE METAL CARBONATITE MASSES
E. B. Rusanov 19 Aug. 1964 8 p refs Transl. into ENGLISH from Razvedka i Okhrana (Moscow), Jul. 1964 p 30–33
(JPRS-25991; TT-64-41262) OTS: $1.00

The results of geophysical methods of investigating carbonatite masses that have a connection with deposits of rare elements (in particular, tantalum and niobium) are discussed. An area in Siberia was chosen where carbonatites constitute 70% of the mass. A survey was conducted with M-2 magnetometers from a network of points 10 × 50 meters with reference points on a grid of 50 × 100 meters. The nonlinear displacement of the magnetic field at the variation station did not exceed 5 to 10 gammas. The magnetometers used had a division value of 25 to 28 gammas, and a temperature coefficient not exceeding 1.2 gammas per degree. Charts were

made of the magnetic field, and graphs were drawn of results of the study, confirming the effectiveness of the use of magnetic survey for investigating carbonatite masses. A.W.

N64-27762 Joint Publications Research Service, Washington, D.C.
INVESTIGATION OF THE PHYSICAL PROPERTIES OF SUBSTANCES AT HIGH TEMPERATURES
I. I. Novikov and P. G. Strelkov 21 Aug. 1964 9 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 6, Jun. 1964 p 26–30
(JPRS-26065; TT-64-41335)

The modulation method for the measurement of heat capacity is described. This method was used to measure the heat capacity of tungsten, tantalum, molybdenum, and niobium. It was found that at high temperatures, the heat capacity of these metals increased due to the formation of vacancies in the crystal grid. Measurement of heat capacity at high temperatures also made it possible to calculate the concentration of these vacancies. A new method of measuring the coefficient of temperature transfer of metals at high temperatures is also discussed. R.T.K.

N64-27819* Marquardt Corp., Van Nuys, Calif.
PLASMA TORCH OXIDATION RESISTANCE AND EROSION. EVALUATION OF PYROLYTIC MATERIALS
S. Sklarew and M. J. Albom [1963] 40 p Presented at the 6th Natl. SAMPE Symp., Seattle, Wash., 18–20, Nov. 1963
(Contract NAS7-54)
(NASA-CR-58148) OTS: $3.60 ph

Pyrolytically derived materials selected for possible use in a free-standing liquid-propellant-rocket thrust chamber were subjected to the effluent of plasma arc heater, which simulated in its composition the combustion products of selected liquid propellants. A principal constituent of this effluent was water vapor (ranging as high as 30%) produced by second-stage injection of oxygen into a stabilized nitrogen–hydrogen plasma. Sample coupons of various pyrolytically derived materials were placed in the arc stream. This report notes the thermal, chemical, and physical effects produced on the test items and compares the candidate materials of construction for the free-standing thrust chamber. Author

N64-27829* Michigan U., Ann Arbor Lab. for Fluid Flow and Heat Transport Phenomena
CAVITATION DAMAGE MEASUREMENTS BY RADIOTRACER ANALYSIS Internal Report No. 23
Frederick G. Hammitt, Willy Smith, Juan Nieto, and M. John Robinson Feb. 1964 38 p refs
(Grant NsG-39-60)
(NASA-CR-58072; Rept.-03424-23-I) OTS: $3.60 ph

No method exists at present for continuous measurement of the cavitation-erosion damage on metallic specimens. By using radioactive isotopes, the development of a technique that would give information not only on wear rate but on debris particle size and composition was attempted. Samples of 302 stainless steel and 1010 carbon steel were irradiated and exposed to cavitation in a venturi. Mercury and water were used as test fluids. Meaningful data were obtained, particularly with respect to particle size distribution and debris components, and their variation with particle size. In the water tests a useful measure of damage rate also was attached. The mercury tests indicated the possible technological difficulties that may be encountered in the application of this method. These are primarily concerned with the capability of the liquid to wet the debris particles and to maintain a uniform slurry. Author

N64-27847 Manlabs., Inc., Cambridge, Mass.
THERMOMECHANICAL TREATMENTS APPLIED TO ULTRA-HIGH STRENGTH STEELS First Progress Report
D. Kalish and S. A. Kulin Jun. 1964 33 p refs
(Contract NOw-64-0356-c)
(AD-603346)

The investigation of the influence of thermomechanical treatments on the mechanical properties of high strength steels is being continued using 9% Ni, 4% Co steels. The variation of fracture toughness with processing conditions is of particular concern. The transformation characteristics, tempering behavior, and mechanical properties of undeformed microstructures are currently being studied. Author

N64-27853 Hydronautics, Inc., Laurel, Md.
CAVITATION DAMAGE
Phillip Eisenberg Dec. 1963 145 p refs
(Contract Nonr-3755(00)FBM)
(TR-233-1; AD-602833)

Cavitation damage was investigated in some detail. The hydrodynamics of cavitation is described. The mechanisms of cavitation damage are discussed. Correlation is made between material properties and susceptibility to cavitation damage. Methods of protection against cavitation damage are presented. Experimental facilities and methods in cavitation damage research are described. G.D.B.

N64-27861 IIT Research Inst., Chicago, Ill. Technology Center
HIGH-TEMPERATURE OXIDATION PROTECTIVE COATINGS FOR VANADIUM-BASE ALLOYS Bimonthly Report, 1 Apr.–31 May 1964
F. C. Holtz 1 Jul. 1964 22 p refs
(Contract NOw-64-0140-c)
(IITRI-B6019-4; AD-603774)

The objective of this program is the development of oxidation protective coatings for vanadium-base alloys for use at 1,800° to 2,500° F. The effect of pack siliconizing on the mechanical properties of 0.20-in.-thick sheet of V-60wt.% Cb–1 wt.% Ti is being studied. Preliminary results indicate that the siliconizing process has no effect on strength, but causes some reduction in tensile ductility. The development of an oxidation resistant slurry or liquid cementation type of coating for V-60 wt.% Cb–1 wt.% Ti is progressing. The static oxidation life of other promising vanadium-base alloys, coated by the pack-siliconizing process, is also being investigated. Author

N64-27868 Navy Electronics Lab., San Diego, Calif.
EFFECTS OF HEAT TREATMENTS ON CAST GOLD ALLOY Research Report, Jan. 1961–Jan. 1964
J. C. Thompson 3 Mar. 1964 25 p refs
(NEL-1211; AD-602131) OTS: $0.75

Specimens of cast gold alloy were subjected to various methods of heat treatment, to determine the effects upon microstructure and hardness. Hardness of the heat-treated specimens was determined with a Tukon tester, using a Knoop indenter. Variations in microstructure were studied by metallographic and photomicrographic examinations. Measurements were made of the temperature generated during grinding and polishing of cast gold. Author

19 MATERIALS, NONMETALLIC

Includes mechanical and physical properties of nonmetals (e.g., plastics). *For related information see*: 07 Chemistry; 17 Machine Elements and Processes; 18 Materials, Metallic; 33 Stresses and Loads; and 34 Structural Design.

N64-27021 Naval Radiological Defense Lab., San Francisco, Calif.

EMITTANCE MEASUREMENTS OF DISILICIDE-TYPE COATINGS AT THE U.S. NAVAL RADIOLOGICAL DEFENSE LABORATORY

N. J. Alvares *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. II Nov. 1963 p 341–351 (See N64-27020 19-01)

The normal spectral emittance and the total hemispherical emittance of oxidation-resistant coatings (PRF-6, C.V. IV (Mo), and Durak-B) were measured on Mo, W, Nb, and Ta, in air, through the useful temperature range. Values of spectral emittance were determined from the true temperature (T_t) and the surface temperature (T_b) using the relation $\ln\epsilon_\lambda = {}^{-}C_2/\lambda (1/T_b - 1/T_t)$. Here C_2 is the second radiation constant, λ is 0.65μ. The temperatures are measured with a micro-optical pyrometer. Total hemispherical emittance measurements were made by a radiometric method using ribbon samples. Specimens 10-mils thick, 1-cm wide, and 12-in. long were suspended vertically within the test chamber by water-cooled supports. I.v.L.

N64-27022* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PRELIMINARY RESULTS OF DIFFUSION STUDIES OF COMMERCIALLY AVAILABLE COATINGS ON Mo-0.5Ti MOLYBDENUM ALLOY SHEET AT 2500° F

W. B. Lisagor and B. A. Stein *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. II Nov. 1963 p 352–369 ref (See N64-27020 19-01)

Diffusion studies were conducted of commercially available silicide base coatings on Mo-0.5Ti. Results are summarized as follows. The hardness traverses showed that for each coating the hardness of the substrate was uniform through the thickness or uniform for the recrystallized and unrecrystallized areas. These data indicate that the application of the coatings investigated did not embrittle the substrate beyond its range of usefulness. This effect was confirmed by tensile test results. The substrate properties were significantly affected by the magnitude of the temperature and time utilized in the coating application and not by the presence of the coating. Hardness values for all specimens after the various 2,500° F exposures in air were also uniform through the substrate thickness. The magnitude of substrate thickness decrease for the coatings was on the order of 0.001 to 0.003 in. in the first 10 hours at 2,500° F. This indicates that solid-state diffusion barriers may be required when coated refractory metals of thin gage are utilized for high-temperature service in aerospace vehicles. I.v.L.

N64-27027 Army Materials Research Agency, Watertown, Mass.

REFRACTORY COATING RESEARCH AND DEVELOPMENT AT U.S. ARMY MATERIALS RESEARCH AGENCY (AMRA)

M. Levy *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. II Nov. 1963 p 450–467 (See N64-27620 19-01)

Emphasis was placed on both flame-spray and plasma-spray techniques for the deposition of coating materials, and data were obtained to determine their adhesion to basic materials. To evaluate the adhesion of coatings to several metallic substrate materials, two methods were used. The first is a tensile-bond method; the second method consists of deforming the specimen beyond the yield point of the metal substrate and then sampling the relative amounts of bare metal and attached coating present. This method is limited to electrically nonconductive coatings. A combined thermal shock and drop apparatus was used to obtain data for flame-sprayed and plasma-sprayed metal, ceramic, and cermet coatings. Several plasma-spray powders were analyzed by X-ray diffraction techniques, before and after deposition, to determine changes in composition brought about by the deposition process. Free standing bodies of various refractory metal, ceramic, and composite materials were formed by plasma deposition on selected mandrels. R.T.K.

N64-27029 Boeing Co., Seattle, Wash.

COATED REFRACTORY ALLOYS FOR THE X-20 VEHICLE

M. Kushner *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. II Nov. 1963 p 483–508 Previously published as N64-80340 (See N64-27020 19-01)

This paper describes the progress made toward the development of design parameters and production methods for the use of coated refractory alloys on the X-20 vehicle. Coating development, test methods, and test data are presented for the TZM and D-36 chosen for use on the vehicle. Author

N64-27031 Dayton U., Ohio Research Inst.

HIGH TEMPERATURE MATERIALS PROGRAMS AT THE UNIVERSITY OF DAYTON RESEARCH INSTITUTE

J. C. Wurst and J. A. Cherry *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, vol. II Nov. 1963 p 517–544 refs (See N64-27020 19-01)

The current high-temperature materials evaluation effort can be separated into two broad categories: the development of evaluation procedures for coated refractory alloys and the development of techniques for the evaluation of a variety of high-temperature materials by means of an arc-plasma-jet. The coatings program has as its goal the development of an orderly series of tests that will provide a comprehensive evaluation of refractory alloy coatings. The general philosophy of this program and specific details of each test are presented. Also treated is the arc-plasma-jet materials evaluation program. This effort has been highlighted in recent months by the conversion of all materials screening to the 100-kw plasma jet, the development of a microablation test for the evaluation of reinforced plastics, and substantial progress in the development of a test apparatus for the evaluation of subscale radiation-cooled nozzles. Author

N64-27032 Picatinny Arsenal, Dover, N.J.

SURVEY OF CERAMIC RESEARCH PROGRAMS SPONSORED BY GOVERNMENT AGENCIES

N. L. Hecht *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. II Nov. 1963 p 545–580 (See N64-27020 19-01)

This survey presents a brief summary and compilation of the ceramic research sponsored by the following Government

agencies—Air Force, Army, Navy, NASA, AEC, and Bureau of Standards. This survey is not an all-inclusive compilation of ceramic research sponsored by agencies of the Government, but rather presents a broad view of the range of efforts and interests of these agencies. Author

N64-27033 Avco Corp., Wilmington, Mass.
PRELIMINARY REPORT ON GRAPHITE COMPOSITES
G. M. Harris *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. II Nov. 1963 p 582–589 (See N64-27020 19-01)

The development of graphite composites for use as heat-shield or rocket-nozzle materials for future spacecraft and missile applications is discussed. The graphite materials studied were tamped, vibrated, or cast into impervious molds or honeycombs. In each cast, the water content was kept to a minimum, and for the vibration troweled mixture, a thixotropic paste was prepared. Samples were dried and fired at low temperatures to enable the colloidal graphite to act as a binder. The graphite skeleton formed by this method was relatively weak but was of sufficient strength to allow for impregnation and curing of the resin system. A wide range of densities was achieved either by a change in graphite from powder to fiber or by altering the ratios of the various constituents. R.T.K.

N64-27034 Aerojet-General Corp., Sacramento, Calif.
MATERIAL-FABRICATION DEVELOPMENT OF A CARBON CLOTH-PHENOLIC ENTRANCE CAP
D. A. Beckley *In* AFSC Summary of the 7th Refractory Composites Working Group Meeting, Vol. II Nov. 1963 p 590–606 (See N64-247020 19-01)

The material and fabrication developments of an entrance-cap insulator containing carbon fabric and phenolic resin are described. Successful firing performance was obtained from a tape-wrapped entrance-cap insulator. A carbon cloth–phenolic material system was developed and provided erosion resistance and thermal protection for nozzle components. The fabrication method is described in detail. R.T.K.

N64-27044 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
THE GLASS AND CERAMICS WORKER Selected Articles
14 Mar. 1963 18 p Transl. into ENGLISH from Sklar Keram. (Prague), no. 4, 1962 p 128–129, 135–137
(FTD-TT-62-1667/1+2; AD-400508)

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1. PREPARING PORCELAIN MASS AND GLAZURE FOR LOWER SINTERING TEMPERATURES R. Reinert p 1–7 (See N64-27045 19-19)

2. JOINTING OF METAL ARMATURES WITH PORCELAIN SLEEVES J. Mracek p 8–15 (See N64-27046 19-17)

N64-27045 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PREPARING PORCELAIN MASS AND GLAZURE FOR LOWER SINTERING TEMPERATURES
Rudolf Reinert *In its* The Glass and Ceramics Worker 14 Mar. 1963 p 1–7 (See N64-27044 19-19)

This report discusses the preparation of porcelain mass for technical porcelain with a maximum sintering temperature of 1,350° C. Technical porcelain differs from luxurious porcelain in that requirements are made only on the mechanical and technical properties of the former. Technical procelain contains kaolin (clay), silicous earth, and quartz. The mechanical and physical properties achieved by a variation in percentage composition of these compounds are discussed. J.LC.

N64-27186 Mare Island Naval Shipyard, Vallejo, Calif. Rubber Lab.
EFFECTS OF VARIOUS ENVIRONMENTS ON THE VIBRATION DAMPING EFFICIENCY OF MONSANTO TREATMENT MRC-OG4
17 Jan. 1963 15 p refs
(Rept.-94-43; AD-294753)

MRC-OG4 is a plasticized, graphite-filled copolymer of vinyl chloride and vinyl acetate that is thermoplastic and flame resistant. The damping characteristics of 0.57-in.-thick slabs of modified MRC-OG4, bonded to 3/8-in.-thick steel bars with an epoxy adhesive, were measured at 74° F over the frequency range of 0.3 kc to 15 kc, both before and after the following conditioning of three separate sets of bars: (1) immersion in JP-5 fuel for 2 weeks at 74° F, (2) immersion in water for 2 weeks at 74° F, (3) oven aging for 2 weeks at 158° F. The results obtained indicate that the treatment initially had damping greater than 3% of critical in the frequency range of 0.3 kc to 9 kc. The results further indicate that the damping efficiency of modified MRC-OG4 was not adversely affected by immersion in JP-5 fuel or water, or by accelerated aging. Author

N64-27212 General Dynamics/Astronautics, San Diego, Calif.
THIRTY DAY EVALUATION OF FOAMS AND HONEYCOMB FOR CENTAUR INTERMEDIATE BULKHEAD
M. D. Campbell, J. F. Haskins, J. Hertz, H. Jones, and J. L Percy 26 Apr. 1962 74 p
(MRG-312)

A 30-day evaluation was run on the thermal and mechanical properties of plastic foams and honeycombs for use as possible backup configurations for the Centaur intermediate bulkhead. Thermal conductivity of plastic foams was determined using spheres of 5.80-in., 7.48-in. and 9.00-in. diameters immersed in liquid hydrogen. Heaters embedded in 1-in.-diameter copper spheres were internally bonded within the foam, and heat was applied to obtain an internal temperature of −297° F. The thermal conductivity of Hexcel HRP-3/16 (5.5 lb/ft^3) fiberglass core was also obtained on flat panels. Compression and shear data were obtained on a series of foams and foam-filled cores from −423° to 78° F. Total thermal expansion of these materials was also obtained over the same temperature range. Fatigue tests at −320° and −423° F were run on foams and foam-filled cores bonded to stainless-steel coupons. Fatigue tests were also run at −320° F on foams bonded to 18-in.-diameter stainless-steel hemispheres. Author

N64-27334 Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS. VOLUME IX: FABRICATION AND PROPERTIES OF CARBONIZED CLOTH COMPOSITES Technical Report, Sep. 1960–Dec. 1962
W. C. Beasley, E. R. Mc Henry, and E. L. Piper Wright-Patterson AFB, Ohio, AF Mater. Lab., May 1964 109 p refs
(Contract AF 33(616)-6915)
(WADD-TR-61-72, Vol. IX; AD-602735)

This report describes the development of fibrous, carbonaceous composites and laminates. Graphite, carbon, and heat-treated cloth and graphite and carbon felts are evaluated as fillers. Physical properties of the carbonized and graphitized forms of these materials are tabulated. Test results of these materials as potential hardware components are presented. Author

N64-27387* Lexington Lab., Inc., Cambridge, Mass.
FEASIBILITY STUDY OF VARIOUS ABSORBITIVITY OXIDES AS AN AID TO SATELLITE TEMPERATURE CONTROL Final Annual Report
A. Waugh 24 Nov. 1962 45 p refs
(Contract NAS5-582)
(NASA-CR-56412) OTS: $4.60 ph

Research discussed in this report is divided into four general categories: (1) a survey of materials to determine which one exhibit phototropy, (2) evaluation of the feasibility of their use as coatings for satellite temperature controls, (3) optimization of their behavior for potential use, and (4) study of the mechanism by which phototropy occurs. A survey of materials underwent an alteration in objective for two reasons. First, the necessary stability in high vacuum in outer space led to the concentration of attention on materials exhibiting phototropy in bulk rather than as superficial reactions. Secondly, the recognition that higher bleach temperatures than 70° C (the limit imposed by the assumption that the required bleach temperature must be equivalent to the operating temperature for transistors and other electronic apparatus) led to the examination of more stable compounds and their behavior at high temperatures. Feasibility of using existing phototropes for partial satellite temperature control was demonstrated for barium titanate-base materials. Coatings of barium titanate powder can be applied to aluminum panels by using sodium silicate cement without reducing the phototropic response of the coating. Author

N64-27407 Bettis Atomic Power Lab., Pittsburgh, Pa.
THERMAL STABILITY EVALUATION OF ELASTOMERIC SEAL MATERIALS
R. E. Moore Jul. 1964 21 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-432) OTS: $0.50

The thermal stability of the following synthetic rubbers was experimentally determined: silicone, ethylene–propylene (EPR and EPT), nitrile (NBR), styrene (SBR), butyl, acrylic, and urethane. These elastomers were tested in air, water, and steam atmospheres over a 150° to 550° F temperature range for 1,000 hours with interim inspections at 100, 250, and 500 hours. Triplicate test specimens were evaluated by visual examination and weight and hardness changes. Halide and sulfur contents of the elastomers were also obtained by chemical analyses. Silicone rubber was found to be best in air (stable to 500° F); the ethylene–propylene rubbers (EPR and EPT) were the most resistant to water (400° to 450° F) and steam (450° to 500° F). These two classes of elastomers were clearly superior to the other materials tested and also showed acceptably low halide contents. Author

N64-27479 Battelle Memorial Inst., Columbus, Ohio
SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I: ELASTOMERIC AND PLASTIC MATERIALS
N. J. Broadway, R. W. King, and S. Palinchak (Battelle Memorial Inst.) Huntsville, Ala., Army Missile Command, 1 Apr. 1964 101 p refs
(Contract DA-01-021-AMC-203(Z))
(RSIC-150, Vol. 1; AD-603364)

This volume covers the following elastomeric and plastic materials: potting (embedding and encapsulating) compounds (polyurethane, epoxy, silicone); insulation, wire (teflon, polyolefins, silicones, PVC, natural resins); sealants; elastomers; lubricants; and coatings (paints, lacquers, anodizing). Author

N64-27480 Battelle Memorial Inst., Columbus, Ohio
SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I: ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX A: ELASTOMERS
Huntsville, Ala., Army Missile Command, 1 Apr. 1964 120 p
(Contract DA-01-021-AMC-203(Z))
(RSIC-150, Vol. I, Append. A; AD-603365) OTS: $6.00

This is a compilation of 58 tables giving detailed information on elastomers, including such aspects as outgassing rates, weight loss in vacuum, physical properties, exposure to high temperature, and other considerations. G.D.B.

N64-27481 Battelle Memorial Inst., Columbus, Ohio
SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I: ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX B: PLASTICS
Huntsville, Ala., Army Missile Command, 1 Apr. 1964 84 p
(Contract DA-01-021-AMC-203(Z))
(RSIC-150, Vol. I, Append. B; AD-603366)

A wide range of environmental tests are reported for plastics in a series of charts and tables. Such items as thermal irradiation, UV exposure, and weight loss rates are included. G.D.B.

N64-27482 Battelle Memorial Inst., Columbus, Ohio
SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I: ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX C: COATINGS
Huntsville, Ala., Army Missile Command, 1 Apr. 1964 63 p
(Contract DA-01-021-AMC-203(Z))
(RSIC-150, Vol. I, Append. C; AD-603367)

Various tests, analyses, and examinations of coatings are presented in tabular form. Composition, exposure to radiation, weight losses, and vacuum-thermal effects are considered. G.D.B.

N64-27483 Battelle Memorial Inst., Columbus, Ohio
SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I: ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX D: STRUCTURAL ADHESIVES
Huntsville, Ala., Army Missile Command, 1 Apr. 1964 39 p
(Contract DA-01-021-AMC-203(Z))
(RSIC-150, Vol. I, Append. D; AD-603368)

The effect of vacuum and elevated temperatures on various structural adhesives is given in tables, along with conditions and results of UV exposure, static tests, and other examinations. G.D.B.

N64-27484 Battelle Memorial Inst., Columbus, Ohio
SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I: ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX E: ELECTRICAL INSULATION

Huntsville, Ala., Army Missile Command, 1 Apr. 1964 23 p
(Contract DA-01-021-AMC-203(Z))
(RSIC-150; Vol. 1, Append. E; AD-603369)

Test environment and results of static testing of electrical insulation and dielectric materials are presented in tables. G.D.B.

N64-27485 Battelle Memorial Inst., Columbus, Ohio
SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I: ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX F: LAMINATES
Huntsville, Ala., Army Missile Command, 1 Apr. 1964 45 p
(Contract DA-01-021-AMC-203(Z))
(RSIC-150, Vol. I, Append. F; AD-603370)

Laminates are discussed in terms of flexural and compressive strength, exposure to UV radiation and high vacuum, and low- and high-force dynamic tests; tables, charts, and graphs related to laminates are also included. G.D.B.

N64-27486 Battelle Memorial Inst., Columbus, Ohio
SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I: ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX G: POTTING COMPOUNDS
Huntsville, Ala., Army Missile Command, 1 Apr. 1964 16 p
(Contract DA-01-021-AMC-203(Z))
(RSIC-150, Vol. I, Append. G; AD-603371) OTS: $2.50

Potting compounds are tabulated to give information on encapsulating materials, weight loss rates, test environment and results of static tests, effect of nuclear radiation in vacuum, and effect of high vacuum and elevated temperature on physical and electrical properties of typical plastic potting compounds. G.D.B.

N64-27487 Battelle Memorial Inst., Columbus, Ohio
SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I: ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX H: SEALS, O-RINGS, AND GASKETS
Huntsville, Ala., Army Missile Command, 1 Apr. 1964 22 p
(Contract DA-01-021-AMC-203(Z))
(RSIC-150, Vol.1, Append. H; AD-603384)

Test results on Buna N O-rings and Neoprene O-rings, as well as on some seals and gaskets, are presented in tabular and graphic form. Stress–strain curves and low force dynamic test results are among the data included. G.D.B.

N64-27488 Battelle Memorial Inst., Columbus, Ohio
SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I: ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX I: RADIATION AT CRYOGENIC TEMPERATURES
Huntsville, Ala., Army Missile Command, 1 Apr. 1964 39 p
(Contract DA-01-021-AMC-203(Z))
(RSIC-150, Vol. I, Append. I; AD-603372) OTS: $3.75

Radiation at cryogenic temperatures is presented in a series of tables and charts as it relates to various coatings, laminates, insulations, seals, and adhesives. G.D.B.

N64-27489 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
DETERMINATION OF ACTUAL SURFACE CONTACT AREAS ON TRANSPARENT MODELS
E. M. Shvetsova 19 Jun. 1964 33 p Transl. into ENGLISH from Inst. Mashinoved. (USSR), Sb. 7, 1953 p 12–33
(RSIC-192; AD-603492)

A new optical method is developed for determining the forms and dimensions of actual contact areas of coarse surfaces on a friction plane. This method permits a visual observation of actual contact areas in models with stationary as well as movable surfaces and a determination of the number of contact spots, the dimensions of separate spots, and the overall actual areas of contact. From this method it is determined that the surface makes actual contact on very small areas grouped in a small number of zones. The main part of the nominal areas of contact does not bear any stress. The actual contact surface comprises a value that is less than 1% of the nominal surface. The actual contact area increases with the increase of the stress, causing an increase in the number of contact points. The diameter of the spots increases insignificantly. The average dimension of a spot comprises a value of the order of 0.02 mm. N.E.A.

N64-27492 Aerospace Corp., El Segundo, Calif. Material Sciences Lab.
MICROPLASTICITY
R. D. Carnahan 15 Jul. 1964 30 p refs
(Contract AF 04(695)-269)
(SSD-TDR-64-124; TDR-269(4240)-10)-14; AD-603050)

This report presents a review of experimental methods for measuring plastic deformation that occurs at strains of $\sim 1 \times 10^{-6}$ in./in. plastic. Dislocation theory is applied to predict microstrain values for selected engineering materials, and calculated and experimental results are compared. It is demonstrated that a simplified theoretical approach can be used to predict the microstrain behavior to be expected for typical engineering materials. Author

N64-27640 Monsanto Research Corp., Dayton, Ohio
A THERMOANALYTICAL INVESTIGATION OF POLYETHER URETHANE ELASTOMERS SUITABLE FOR ROCKET PROPELLANT BINDERS Technical Documentary Report, Jul. 1962–Jul. 1963
Harry S. Wilson, Ival O. Salyer, and J. E. Katon Wright-Patterson AFB, Ohio, AF Materials Lab., Apr. 1964 108 p refs
(Contract AF 33(616)-8465)
(ML-TDR-64-65; AD-601372)

To elucidate the firing instability encountered by the Air Force with some aged polyurethane rockets, which results in loss of chunks of propellant, an analytical investigation of thermal characteristics and stability was conducted on model compounds prepared from typical propellant raw materials, and on model propellant binder samples formulated with ammonium perchlorate to duplicate the chemical effects of the oxidizer. Formulation variables, catalysts, and atmosphere all affected thermal characteristics somewhat, but caused no catastrophic changes. A thermal popcorn effect was encountered at 300° to 350° C with samples exposed to atmospheric moisture and containing large excesses of isocyanate. This effect, which is at least qualitatively similar to the aged propellants' firing instability, can be accounted for by volatilizations and dissociations that occur below urethane dissociation temperatures. The mathematics of steady-state propellant burning and pop-corning are discussed. This popcorn effect, plus the low tensile strength of present urethane propellant binders, is proposed as the most likely explanation of the firing failures of these grains after extended storage. Analytical correlations for infrared assignments, proton resonance (NMR) assignments, and thermogravimetric analyses were developed for application to polyurethanes. Author

N64-27774 Air Force Systems Command, Wright-Patterson AFB, Ohio Research and Technology Div.
PLASTICS IN THE AIR FORCE Technical Documentary Report, Apr.-Nov. 1963
D. L. Schmidt and R. C. Tomashot Apr. 1964 36 p refs
(ML-TDR-64-76; AD-601555)

Plastic materials that possess many unique properties are being used effectively in Air Force applications. Of particular importance are their high-temperature, structural, electrical, and ablative properties. This report describes the utilization of such properties in various airborne and aerospace applications. Author

N64-27788 Rock Island Arsenal Lab., Ill.
THE COMPOSITE-COMPONENT PROPERTY RELATIONSHIP OF PLASTIC FILMS
L. W. Lynch 4 Mar. 1964 17 p refs
(RIA-64-731; AD-602715) OTS: $0.75

The relationship of certain properties of composite plastic films to the properties of the plastic films comprising their structure was studied. Tensile, tearing strength, puncture resistance, and moisture vapor transmission rates of composite films can be closely approximated by calculations based on the component properties. The theoretical values are not valid if deteriorating substances are allowed in contact with susceptible plastics during the composite fabrication. Author

N64-27859 Picatinny Arsenal, Dover, N.J. Plastics Technical Evaluation Center
A REVIEW OF PLASTICS FOR TOOLING: MATERIALS, TECHNIQUES, TOOL DESIGN
Nicholas T. Baldanza Mar. 1964 156 p refs
(PLASTEC-15; AD-601391) OTS: $3.00

A review of the fabrication of prototype and production tools from plastics is presented. The materials usually involved in plastics tooling are discussed as to their capabilities and properties. The processing and fabrication techniques selected for review and comment are typical of the art, and are applicable to making tools for the production of metal and plastic components. Potentials for the military use of plastics tooling are noted. Design considerations encompass the making of models, dies, production aids, foundry tools, and molds. Test methods are identified, and optical methods for checking surface contour are discussed. Author

20 MATHEMATICS

Includes calculation methods and theory; computers; data processing; and numerical analysis. *For related information see*: 08 Communications; 09 Electronics; 10 Facilities, Research and Support; and 22 Navigation and Guidance.

N64-27082 Aerospace Corp., Patrick AFB, Fla.
QLAP REQUIREMENTS, PART II
M. Schauerman 1 Aug. 1964 160 p refs
(Contract AF 04(695)-469)
(TOR-469(A5126-10)-2, Vol. 1; AD-443837)

Part II of the Gemini Quick Look Analysis Program (QLAP) involved processing the engineering unit tapes along with supplemental meteorological information and tracking data, using equations programed to produce output parameters and plots for the analysis of Gemini vehicle performance. The program input information and the computer program are described. R.T.K.

N64-27165 Joint Publications Research Service, Washington, D.C.
REDUCTION IN THE NUMBER OF TRIALS WHEN SOLVING SOME PROBLEMS OF THE SYNTHESIS OF DISCRETE AUTOMATA
A. D. Zakrevskiy *In its* Izv. VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 244-256 refs (See N64-27151 19-08) OTS: $4.00

The problem is considered of reducing the number of trials when solving certain problems from the field of synthesis of discrete automata, and a procedure is proposed for programing these trials on universal computers. An algorithm for the transformation R(C) of a Boolean matrix C, based on one of these methods of trial, is proposed; the best known interpretation of this transformation is the transition from a set of simple implicants of a Boolean function to a set of its impassable disjunctive normal forms. Author

N64-27215 California U., Los Angeles
SIMPLIFIED PREDICTOR-CORRECTOR METHODS Technical Report
M. Alan Feldstein and Hans J. Stetter Aug. 1963 15 p refs Presented at the 1963 ACM Natl. Conf., Denver, Colo.
(Sponsored by AF and Navy)
(AD-433914)

In order to minimize the number of function evaluations per step in the numerical solution of a class of differential equations, a simplified predictor-corrector method is presented, and a detailed analysis of the growth of the accumulated discretization error is given. Theorem I establishes the order of the discretization error, and its result will be used to derive Theorem II, giving an asymptotic expression for the error. The simplified algorithm generates a more accurate approximation to the true solution than the customary method. Results of numerical computations are also presented. D.S.G.

N64-27228 Wissenschaftliche Gesellschaft für Luft- und Raumfahrt, Cologne (W. Germany)
LIGHT METALS AND NON-METALLIC MATERIALS Report on The First Joint Meeting of the Subcommittee [LEICHTMETALLE UND NICHTMETALLISCHE WERKSTOFFE Bericht über Die 1. Gemeinsame Sitzung der Unterausschüsse]
A. Martin et al (Leiden U.) [1963] 121 p refs Conf. Held at Bremen, 8-9 Apr. 1963 In GERMAN
(WGLR-1/1964) Available from WGLR-Hauptgeschäftsstele, Martinstr. 40-42, Cologne, W. Germany: 31 DM

Studies are reported on adhesive materials for construction, point-wise fast age-hardening of metal adhesive compounds, modern problems and experiences in the area of adhered aircraft constructions, stress distribution in metal adhesive compounds, metal adhesive compounds under corrosion, and possibilities for the nondestructive testing of metal adhesive compounds. D.E.W.

N64-27280* Franklin Inst., Philadelphia, Pa. Labs. for Research and Development
A COMPUTER SOLUTION FOR HYDROSTATIC BEARINGS WITH VARIABLE FILM THICKNESS Final Technical Report

J. G. Hinkle and V. Castelli 11 Jan. 1963 80 p refs Prepared for JPL
(Contract JPL-950448)
(NASA-CR-56898; F-B2015) OTS: $7.60 ph

Basic equations, numerical approximations, method of solution, numerical treatment, and the FORTRAN program are presented, along with instructions on the use of the program and a sample problem. Author

N64-27325 General Electric Co., Philadelphia, Pa. Space Sciences Lab.
ON THE TWO POINT BOUNDARY VALUE PROBLEM, WITH APPLICATION TO CELESTIAL MECHANICS
Murray Wachman Aug. 1964 35 p refs
(R64SD57)

This paper gives local existence and uniqueness theorems for two-point boundary-value problems of systems of second-order ordinary differential equations. It also explores under what conditions these theories may be extended beyond their local limitations. For a class of equations, these theorems result in a numerical method for solution of the two-point boundary-value problem. Author

N64-27326* Massachusetts Inst. of Tech., Cambridge Experimental Astronomy Lab.
SINGULARITIES IN THE ANALYTIC SOLUTION OF THE LINEARIZED VARIATIONAL EQUATIONS OF ELLIPTICAL MOTION
Robert G. Stern N.Y., AIAA [1964] 13 p refs Presented at the 1st AIAA Ann. Meeting, Washington, D.C., 29 Jun.–2 Jul. 1964
(Contract NAS9-153; Grant NsG-254-62)
(AIAA Paper-64-398) AIAA: $0.50 members, $1.00 nonmembers

A series of three second-order differential equations is presented, and the singularity conditions thereof are discussed. Lamber's theorem is used to interpret the X=0 type of singularity. The time of flight for a one-way trip from Earth to Mars is plotted, and fixed-time-of-arrival guidance allowed for in the correction of vehicular trajectories. When the nature of the space mission is such that time of arrival need not be rigidly constrained, velocity correction may be expressed in terms of only two components of the predicted position variation at arrival time. A.W.

N64-27327* National Aeronautics and Space Administration, Washington, D.C.
METHOD OF TRANSFER FROM LOGICAL SCHEMES OF ALGORITHMS TO BOOLEAN FUNCTIONS [O METODE PEREKHODA OT LOGICHESKIKH SKHEM ALGORITMOV K BULEVYM FUNKTSIYAM]
V. F. D'yachenko Jun. 1964 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Tekhn. Kibernea, no. 6, 1963 p 128–130
(NASA-TT-F-9006) OTS: $1.60 ph

A method is discussed for obtaining the Boolean functions describing the structure of a control circuit by means of AS operators whose sequence of operations is given in the form of a logical scheme or matrix scheme for an algorithm. An example of AS synthesis is given. Author

N64-27366* National Aeronautics and Space Administration, Washington, D.C.
PROBLEMS OF RELIABILITY AND SEARCH FOR MALFUNCTIONS IN SYSTEMS TAKING INTO ACCOUNT THE PROBABILITY REGIME OF THE USE OF ELEMENTS [VOPROSY NADEZHNOSTI I POISKA NEISPRAVNOSTEY V SISTEMAKH S UCHETOM VEROYATNOSTNOGO REZHIMA ISPOL'ZOVANIYA ELEMENTOV]
S. Yu. Ruderman Jun. 1964 18 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Tekhn. Kibernetika (Moscow), no.6, 1963 p 131–138
(NASA-TT-F-9007)

An analysis is made of system reliability, taking into account the different effects of the "operating" and "standby" states on the reliability of elements. Discussed is the problem of organizing a special hierarchical structure inside a system in order to bring about a sort of optimization for the process of finding and correcting failures, and thus prevent breakdown of the entire device. The probability of operation without failures under these conditions is calculated. Author

N64-27372 Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium)
NOTE ON THE USE OF CHEBYSHEV POLYNOMIALS FOR INTEGRATION OF ORIDINARY DIFFERENTIAL EQUATIONS
L. Moulin Jun. 1964 28 p refs
(Grant AF-EOAR-63-39)
(VKI-TN-18; SR-4)

The problem of obtaining approximate solutions to ordinary differential equations is discussed with reference to methods that are already in existence. In addition, the possibility has been considered of using direct expansions in Chebyshev polynomials. The analysis indicates that such a method compares favorably with other methods and may offer further advantages. Its application can be easily extended to the case of nonlinear equations. Author

N64-27416 Royal Aircraft Establishment, Farnborough (Gt. Brit.)
A POSSIBLE METHOD FOR COMPUTING OPTIMUM PAYLOADS AND TRAJECTORIES AND FOR THE FORMULATION OF GUIDANCE LAWS FOR SATELLITE LAUNCHERS
K. H. E. Schirrmacher Mar. 1964 9 p
(RAE-TM-SPACE-32; AD-441601)

A method is proposed that might enable the execution of payload optimization calculations for satellite launching vehicles in a shorter time than that required by using calculus of variation methods. The calculations are based on the instantaneous trajectory values and do not require an assumption of future acceleration. Although it is anticipated that numerical methods must be employed, the reduction of computation time stems from the fact that the proposed method is essentially a differentiation process and not a split boundary problem. Author

N64-27439 New York U., N.Y. Courant Inst. of Mathematical Sciences
ASYMPTOTIC METHODS FOR THE SOLUTION OF DISPERSIVE HYPERBOLIC EQUATIONS
Robert M. Lewis Apr. 1964 77 p refs
(Contract AF 19(628)-3868)
(AFCRL-64-387; EM-197; AD-602235) OTS: $2.00 ph

A general method is presented for finding asymptotic solutions of initial boundary value problems for linear hyperbolic partial differential equations. A large parameter λ appears in the equation, multiplying a lower order (dispersive) term. It also may appear in the initial data and the inhomogeneous (source) term, in a variety of ways. This gives rise to a variety of different types of asymptotic solutions. The expansion procedure is a "ray method"; i.e., all of the functions that appear in the expansion satisfy ordinary differential equations along certain space–time curves called rays. These rays do not lie on characteristic hypersurfaces, but instead fill out the interior of the characteristic hypercone. They are associated with an appropriately defined group velocity. The details of the expansion are presented for a simple second-order hyperbolic equation. The applicability of the method to symmetric hyperbolic systems and to the integro-differential equations for dispersive dielectrics is discussed. Author

N64-27472 Aerospace Corp., El Segundo, Calif. Electronics Div.
THE DEVELOPMENT OF THE COVARIANCE MATRIX FOR SYSTEM PERFORMANCE EVALUATION
J. C. Peale 30 Jun. 1964 39 p ref
(Contract AF 04(695)-269)
(SSD-TDR-64-143; TDR-269(4540-70)-6; AD-603193)

This report presents a general approach to performance evaluation of a system. It develops the covariance matrix based on first principles of statistics. By obtaining estimates of the statistical behavior of fundamental error sources within the system and parametric equations defining the system, the covariance matrix of the system outputs may be developed in a routine manner. To demonstrate the application of the covariance matrix, a discussion is included on how the elements of the matrix are obtained for an inertially guided missile system; however, the method has general systems application. With a computer simulation program such as the Aerospace Modularized Vehicle Simulation, the partial derivatives required to develop the covariance matrix are readily obtained by first differences. Author

N64-27522 Lincoln Lab., Mass. Inst. of Tech., Lexington
ANALOG ORBIT COMPUTER Group Report
N. P. Smith and S. H. Smith 16 Apr. 1964 21 p
(Contract AF 19(628)-500)
(ESD-TDR-64-49; AD-600956)

The problem of pointing an instrument on the earth's surface at an object in orbit about the earth is investigated. Necessary expressions are derived for calculating continuously azimuth, elevation, range, and range rate from inputs of instrument site and orbit parameters. An electromechanical orbit computer capable of performing the required mathematical operations is described. Test results are listed for a similar computer used against a typical orbiting body. Author

N64-27532 Stanford Research Inst., Menlo Park, Calif.
SOME SPECIAL PROPERTIES OF THE MEB-PSD FUNCTION, ITS COMPONENTS AND MOMENTS
R. C. Mc Carty, G. W. Evans, II, G. L. Sutherland, and Z. W. Birnbaum May 1964 42 p refs
(Contract ARPA SD-103; ARPA Order-281-62)
(TR-21; AD-442144)

Several special mathematical properties of the MEB (McCarty, Evans, and Birnbaum) power spectral density (PSD) function are presented, and a generalization for the definition of the MEB–PSD function is discussed. Included are discussions of the following: PSD analysis of polynomials; PSD analysis of the sum of two deterministic functions; an example of a deterministic function requiring the generalized PSD definition; and the average autocovariance of M member functions $y_m(t)$. P.V.E.

N64-27545 Stanford U., Calif. Applied Mathematics and Statistics Labs.
AN ACCURATE ALGORITHM FOR THE SOLUTION OF SIMULTANEOUS LINEAR ALGEBRAIC EQUATIONS
William M. Mc Keeman 18 Jan. 1963 38 p refs
(Contract Nonr-225(37))
(TR-26; AD-229111)

The application of gaussian elimination to the solution of simultaneous linear algebraic equations for a nonspecial matrix of coefficients has appeared in many forms. A given algorithm may search a column for the largest pivotal element or may search the entire matrix for it; it may accumulate inner products, scale the matrix initially, or iterate to improve the solution. Presented is an evaluation of the various alternatives on the experimental bases of accuracy, speed, and reliability. P.V.E.

N64-27546 Stanford U., Calif. Applied Mathematics and Statistics Labs.
ON ESTIMATING THE "RATES OF CONVERGENCE" OF ITERATIVE METHODS FOR ELLIPTIC DIFFERENCE EQUATIONS
Seymour V. Parter 28 Feb. 1963 60 p
(Contract Nonr-225(37); Grant NSF-G-18837)
(TR-28; AD-298999)

In order to compare iterative methods for the numerical solution of elliptic difference equations, it is necessary to estimate the rates of convergence. A general analysis of certain aspects of this general estimation problem is presented. The general approach that is used permits a discussion of both the Neumann problems and the Dirichlet problems. P.V.E.

N64-27568 Princeton U., N.J. Frick Chemical Lab.
DATA PROCESSING, LEAST SQUARES PREPARATION, AND PATTERSON SHARPENING PROGRAMS FOR THE CONTROL DATA CORPORATION 1604 Technical Report No. 4
B. T. Gorres and R. A. Jacobson 1 Aug. 1963 101 p refs
(Grant DA-ARO(D)-31-124-G265)
(AROD-30839; AD-434158)

The programs described in this report were written to aid in the correction and interpretation of data from a single crystal orienter. A special program, designed to treat corrected $|F_d|$'s, was written to remove the dependence on the method of observation. The programs are applicable to triclinic, monoclinic, and orthorhombic space groups. Data processing programs preserve pertinent data on magnetic tape for later use in Patterson sharpening or least squares refinement programs. All programs were written in assembly form and operate in basic machine language. Author

N64-27700 Harvard U., Cambridge, Mass. Cruft Lab.
ON THE CONJUGATE POINT CONDITION FOR THE CONTROL PROBLEM
J. V. Breakwell and Yu-Chi Ho (Stanford U.) 26 Mar. 1964 29 p refs
(Contract Nonr-1866(16))
(TR-441; AD-601392) OTS: $0.75

This report derives the conjugate point condition in the calculus of variations for a general control problem. Although the results presented can be derived by appropriate identification with those from the classical Bolza problem, it is felt that a direct derivation with control theoretic interpretation will be useful in providing an intuitive understanding of the meaning of a conjugate point. Also discussed are the relationship between normality and controllability, the sufficiency condition for weak and strong relative minimum, and the accessory minimization problem. Author

N64-27703 Michigan U., Ann Arbor
ON A NEW PERTURBATION METHOD
Richard Yee Yen Lee (Ph.D. Thesis) 1964 125 p refs
(Contract Nonr-1224(15); Grant NSF GP-1536)
(AD-601184) OTS: $2.75

A formal and systematic development of the method is given to show how the secular terms can be eliminated. The formulas obtained are applied to some simple examples with a finite number of degrees of freedom, especially to the problem of magnetic resonance. A brief derivation is given of the conventional Rayleigh–Schrodinger perturbation formulas of quantum mechanics. Some problems with continuous degrees of freedom are dealt with prior to the treatments of the kinetic equations that comprise the major part of this work. Kinetic equations of various types are derived, depending on the perturbation parameter and are solved both with classical mechanics and with quantum mechanics. In the latter case, problems concerning spin and symmetry are also treated. Author

N64-27705 Northrop Corp., Newbury Park, Calif. Ventura Div.
ON THE SOLUTION OF THE FUNDAMENTAL PROBLEMS OF THE THEORY OF ELASTICITY [UBER DIE LOSUNG DES GRUNDPROBLEMS DER ELASTIZITATSTHEORIE]
A. Korn 1 Apr. 1964 65 p refs Transl. into ENGLISH from Math. Ann. (Leipzig), v. 75, 1964
(Rept.-2993; AD-601030)

This study shows how simple the solution of the fundamental problem of the theory of elasticity becomes upon application of improvements to previous methods. The fundamental problem of the elasticity theory not only includes the first boundary-value problem of elasticity, but also the biharmonic problem and the first boundary-value problem of the theory of viscous flow. G.D.B.

N64-27714 Wisconsin U., Madison Mathematics Research Center
SOME CONSIDERATIONS IN PRACTICAL COMPUTATION
A. S. Chai and H. J. Wertz May 1964 25 p refs
(Contract DA-11-022-ORD-2059)
(MRC-469; AD-603284)

This paper considers some typical problems encountered in general scientific computation. In particular, it treats some of the errors that occur in the evaluation of an integral. Four methods are considered in detail, two of which are called exact, because the operation of integration is done analytically, and two of which are particular numerical integration schemes. In all cases careful attention is given to the problems of running time, estimation of truncation error, and estimation and control of roundoff error. Author

N64-27715 Wisconsin U., Madison Mathematics Research Center
THE BAUER FIELDS OF VALUES OF A MATRIX
Nicholas Nirschl and Hans Schneider Apr. 1964 25 p refs
(Contract DA-11-022-ORD-2059; Grant NSF GP-2273)
(MRC-475; AD-603285)

Let A be a linear transformation on a finite dimensional Euclidean space. The classical field of values of A consists of all complex numbers of form (x,Ax) where $(x,x) = 1$. F. L. Bauer has defined the field of values with respect to an arbitrary homogeneous norm $\|\cdot\|$ to be $F[A,\|\cdot\|] = \{(y,Ax) : (y,x) = \|y\|', \|x\| = 1\}$, where $\|\cdot\|'$ is the norm dual to $\|\cdot\|$. Let $F^c[A,\|\cdot\|]$ be the convex closure of $F[A,\|\cdot\|]$. If $P[A]$ is the convex hull of the eigenvalues of A, it is shown that $P[A]$ is the intersection of $F^c[A,\|\cdot\|_G]$ over all nonsingular diagonal G, where $\|x\|_G = \|Gx\|$. For a wide class of norms (including, in particular, all Hölder norms) it is proved that there exists a G such that $P[A] = F^c[A,\|\cdot\|_G]$ if and only if all eigenvalues of the boundary of $P[A]$ have simple elementary divisors. For the case of the Euclidean norm $\|\cdot\|$, these results are known and due to Givens. Author

N64-27716 Wisconsin U., Madison Mathematics Research Center
INTERPOLATION BY GENERALIZED SPLINE FUNCTIONS
T. N. E. Greville May 1964 46 p refs
(Contract DA-11-022-ORD-2059)
(MRC-476; AD-603290)

A generalized spline function with respect to a given ν-dimensional function space $S \subset C^{\nu}[a, b]$ is defined as a function in $C^{\nu-2}[a, b]$ which, in each of $n + 1$ subintervals of $[a, b]$, is identical with some function in S. A simple representation for such a function in terms of $n + \nu$ parameters is derived. The problem is considered of finding the smoothest interpolating function f for $n (\geq \nu)$ given data points with abscissas in $[a, b]$ in the sense that $\int_a^b [T_S f(x)]^2 dx$ is minimized, where T_S is the linear differential operator whose null space is S. If the Wronskian of a basis for S is nonvanishing on $[a, b]$, there is a unique solution, which is a generalized spline function with respect to a 2ν-dimensional space $\Sigma \supset S$. A different criterion of best interpolation due to Sard is shown to lead to the same solution. The case in which T_S has constant coefficients is considered separately. In the restricted case of constant coefficients in T_S and equally spaced abscissas of the data points, a form of preliminary analysis to assist in choosing S is proposed. Author

N64-27717 Wisconsin U., Madison Mathematics Research Center
THE SEMI-INFINITE STRIP
M. W. Johnson, Jr., and Robert W. Little May 1964 25 p refs
(Contract DA-11-022-ORD-2059)
(MRC-478; AD-603286)

The edges of a strip of infinite length are taken free of stress, whereas the edge of finite length is assumed to have either stress, displacement, or mixed boundary conditions. The equations are put in the form of a system of first-order equations and solved by means of a generalized Fourier series. For the mixed end conditions the Fourier coefficients are given by formulas. For the stress and displacement problems the coefficients must be determined from an infinite set of equations. A numerical example is solved for the stress problem. Author

N64-27718 Wisconsin U., Madison Mathematics Research Center
ELASTICITY SOLUTION OF FLEXURE, TORSION AND BUCKLING OF MULTI-LAYERED BEAMS
Shun Chen May 1964 20 p refs
(Contract DA-11-022-ORD-2059)
(MRC-483; AD-603288)

This paper is concerned with the problem of flexure and torsion of multilayered beams of uniform cross section having one end fixed and the other end loaded by transverse forces. Stresses and deflections are obtained. These results are also applicable to the problems of simply supported or clamped beams loaded by a concentrated load at its middle span. The results of the analysis of flexure of multilayered beams may be used to calculate Euler's buckling load. Author

N64-27768 United ElectroDynamics, Inc., Alexandria, Va. Earth Sciences Div.
NEW SOLUTIONS OF THE LAPLACE EQUATION IN SPHERICAL COORDINATES
Johann Martinek and Henry P. Thielman 17 Jun. 1964 11 p refs
(Contract AF 33(657)-12447; Proj. Vela-Uniform)
(Rept.-105; AD-441308)

New independent solutions $\psi(\tau,\theta,\phi)$ of the Laplace equation in spherical coordinates are found from any given solution $\phi_0(\tau,\theta,\phi)$. An operator A is constructed such that $\Delta[A\phi_0(\tau,\theta,\phi)]$ is a function of the form $F(\tau)$. $G(\theta,\phi)$; then (1) $\psi(\tau,\theta,\phi) = A\phi_0(\tau,\theta,\phi) + f(\tau).g(\theta,\phi)$ where $f(\tau)$ and $g(\theta,\phi)$ are chosen so that $\Delta\psi(\tau,\theta,\phi) = 0$. This yields $f(\tau) = \tau^{-k}$ and inhomogeneous differential equations of the Poisson and Schroedinger type for $g(\theta,\phi)$. Substituting the solutions of these equations into (1) gives the new harmonic functions $\psi(\tau,\theta,\phi)$. These harmonic functions are important for boundary-value problems related to the sphere. Author

N64-27795* Wisconsin U., Madison Theoretical Chemistry Inst.
EXPANSIONS OF INTEGRALS OF BESSEL FUNCTIONS OF LARGE ORDER
C. F. Curtiss Repr. from J. Math. Phys., v. 5, no. 4, Apr. 1964 p 561–564
(Grant NsG-275-62(4180))

Series expansions in powers of $1/\nu$ of integrals over x of the product of the Bessel function $J_\nu(\nu x/y)$, $[J_\nu(\nu x/y)]^2$, or $J_\nu(\nu x/y)$, $[J_\nu(\nu x/y)]^2$, or $J_\nu(\nu x/y)\, J^{\nu}+_1(\nu x/y)$ with an arbitrary function of a restricted class are developed. Author

21 METEOROLOGY

Includes climatology; weather forecasting; and lower atmosphere studies. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 29 Space Sciences.

N64-27063 Joint Publications Research Service, Washington, D.C.
WEATHER CONTROL OF THE FUTURE
I. Litvinov 11 Aug. 1964 13 p Transl. into ENGLISH from Znaniye-Sila (Moscow), no. 6, Jun. 1964 p 20–24
(JPRS-25845; TT-64-41116) OTS: $1.00

The possibilities of weather control are explored. Practical difficulties and past successes are reviewed, and an understanding of natural atmospheric processes is said to be necessary to effectively control the weather. A hypothetical experiment is described, and a forecast of research results is presented. D.E.W.

N64-27074 Canada Dept. of Transport, Toronto Meteorological Branch
A CONTRIBUTION TO THE DETERMINATION OF VERTICAL VELOCITY AND PRECIPITATION RATE PATTERNS ASSOCIATED WITH A DEVELOPING COLD LOW AT 500 MB
W. S. Harley 13 Jan. 1964 25 p refs
(CIR-3961, TEC-496)

Computed vertical velocity and precipitation-rate fields associated with a developing cold low at 500 mb are presented, and the relation of these fields to those of surface pressure, 500-mb contours, and frontal structures are demonstrated. In the developing cold low situation investigated in this paper, the main center of ascending motion is found about 100 nmi north of the surface position of the low center. The corresponding subsidence center is located about halfway between the surface high- and low-pressure centers, and slightly off line. The centers of ascending motion associated with the weak waves on the maritime and Arctic fronts are found about 450 and 200 nmi, respectively, ahead of and in the direction of motion of the surface wave. As the low pressure area deepens, the fields of ascending motion and precipitation rotate in an anticlockwise sense round the 500-mb low center to a location east–northeast of the latter at the time of maximum deepening. At the same time, the subsidence center moves in the same sense into the broad trough south of the 500-mb low. Author

N64-27134* Consultants and Designers, Inc., Arlington, Va.
MEASUREMENT OF ATMOSPHERE TRANSPARENCY IN THE 0.87 MM WAVE [IZMERENIYE PROZRACHNOSTI ATMOSFERY NA VOLNE 0.87 MM]
V. Ya. Ryadov, N. I. Furashov, and G. A. Sharonov 27 Jul. 1964 11 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 9, no. 6, Jun. 1964 p 943–949
(Contract NAS5-3760)
(NASA-TT-F-8931; ST-RA-10177)

Absorption in the atmosphere transparency window, centered to mean wavelength $\lambda_{aver} = 0.87$ mm, is measured by a radioastronomical method, using the observation data of sun's emission in the spectral interval of 0.9 $cm^{-1}(\Delta\lambda/\lambda_{aver} = 0.08)$. The mean water vapor absorption factor in this band, converted to moisture $\rho_o = 7.5$ g/m^3 and atmosphere pressure at sea level, was equal to 10.4 db/km. At the same time, the minimum value of the absorption factor in this window, obtained for $\lambda = 0.87$ mm taking into account the theoretical dependence of the absorption on wavelength, constituted 8.5 db/km. Comparison is made between the results of the experiment and the theoretical data. Author

N64-27217 Michigan U., Ann Arbor
RAINDROP-SIZE STUDIES Final Report
A. Nelson Dingle Oct. 1963 30 p refs
(Contract AF 19(628)-281)
(AFCRL-63-906; Rept.-05016-2-F; AD-437861)

Qualitative analysis of raindrop-size distributions in heavy showers indicates that some of their prominent features can be explained by the combined effects of wind-shear

sorting of drops and of the splashing of large drops upon surface obstructions. Computational studies that account for the effects of cloud-droplet accretion, raindrop coalescence, and evaporation processes indicate that, in steady-state rain, the origin of large drops lies in snow-aggregation processes above the melting layer. Extending this finding to speculate upon observed differences between heavy shower drop-size distributions in June as compared to October, it is suggested that the relative predominance of the ice-crystal or water-drop processes in convective storms may be indicated by features of the ground-level drop-size distributions. Author

N64-27329 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ON THE QUESTION OF THE DAILY VARIATION OF CLOUDINESS IN THE SOVIET UNION

O. D. Kondrau 28 Apr. 1964 15 p refs Transl. into ENGLISH from Gl. Geofiz. Observ. (USSR), no. 142, 1963 p 22–31 (FTD-TT-63-1205/1+2+4; AD-600525)

In investigating the daily variation in cloudiness it is necessary to take into consideration both climatological data for 0100, 0700, 1300, and 1900 mean solar time, and synoptic observation data. Cloud cover observations for 2 to 3 years make it possible to establish basic daily variation regularities both for mean cloudiness and for the probability of an overcast or clear sky. The greatest changes in cloudiness (in its daily variation) are observed in the hours closest to sunrise and sunset. The greatest amplitude of the daily variation of cloudiness must be expected in the mountains of Central Asia. Author

N64-27398* National Severe Storms Project, Kansas City, Mo.

[TURBULENCE DATA ACQUISITION AND THE EFFECT OF TURBULENCE ON AIRCRAFT] Final Report

J. T. Lee Washington, Weather Bureau, Aug. 1963 147 p refs (NASA Order R-55) (NASA-CR-53381) OTS: $11.00 ph

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N64-27399* National Severe Storms Project, Kansas City, Mo.

THUNDERSTORM TURBULENCE MEASUREMENTS BY AIRCRAFT AND CONCURRENT RADAR ECHO EVALUATIONS

J. T. Lee *In its* [Turbulence Data Acquisition and the Effect of Turbulence on Aircraft] Aug. 1963 62 p refs (See N64-27398 19-21) OTS: $11.00 ph

A study was made of a number of controlled aircraft penetrations of thunderstorms in order to define the most critical areas so that suitable avoidance procedures may be developed. The relationship between thunderstorm growth, radar measurements, and atmospheric turbulence was investigated. A brief résumé of turbulence, turbulence measurements, and radar reflectivity concepts is given as background material. Case studies, along with data from previous reports, show that there appears to be no direct correlation between radar-echo intensity or gradients of successive radar reflectivity values, per se, and turbulence. Rather, there appears to exist a positive correlation between turbulence and rate of change in radar reflectivity. The preponderance of evidence indicates that the center and western portions of thunderstorm complexes, as seen at a zero attenuation level (i.e., lowest Z value), contain the most severe turbulence. Also, altitude changes occurring during thunderstorm penetrations are given to indicate the amount of airspace required by an aircraft. I.v.L.

N64-27400* National Severe Storms Project, Kansas City, Mo.

ON VECTORING AIRCRAFT THROUGH THUNDERSTORMS

C. F. Van Thullenar *In its* [Turbulence Data Acquisition and the Effect of Turbulence on Aircraft] Aug. 1963 18 p (See N64-27398 19-21) OTS: $11.00 ph

The National Severe Storms Project has been involved in successfully vectoring military aircraft through thunderstorms within a radius of 150 nm of Oklahoma City, from 1960 through 1963. Most of these penetrations have been made at altitudes in excess of 25,000 ft. All aircraft were ground-based radar controlled. The team handling the penetrations always consisted of a meteorologist, a representative of the Air Force, Aeronautical Systems Division, Wright-Patterson AFB, Ohio, and a controller. With the possible exception of 1960, penetration aircraft could be fairly accurately vectored into any preselected portion of the thunderstorm. Damage to aircraft due to turbulence, water erosion, and/or hail did occur, but never caused complete disabling of the aircraft or more than a few days down-time for repairs. There were several instances when aircraft instrumentation was damaged to the extent where a lead aircraft was required to bring back the damaged plane to base. I.v.L.

N64-27401* National Severe Storms Project, Kansas City, Mo.

VERTICAL VELOCITY AS EXPRESSED BY THE HORIZONTAL EQUATION OF MOTION

Dansy T. Williams 24 Jan. 1962 *In its* [Turbulence Data Acquisition and the Effect of Turbulence on Aircraft] Aug. 1963 12 p (See N64-27398 19-21) OTS: $11.00 ph

The horizontal equation of motion in expanded and manipulated to show vertical motion in terms of the features of horizontal flow. These features are the horizontal wind field itself and its ageostrophicity, acceleration, divergence, vorticity, deformation, and vertical shear. Certain features of the flow can sometimes be used qualitatively to determine the direction of vertical motion. Author

N64-27402* National Severe Storms Project, Kansas City, Mo.
A DYNAMIC-KINEMATIC METHOD FOR COMPUTING VERTICAL MOTION
Dansy T. Williams 11 Feb. 1963 *In its* [Turbulence Data Acquisition and the Effect of Turbulence on Aircraft] Aug. 1963 35 p (See N64-27398 19-21) OTS: $11.00 ph

A method is presented for computing vertical velocity from winds aloft and contour height data. The values computed are instantaneous but are means with respect to small horizontal areas and shallow layers. The method is based on solutions to the first two equations of motion. As a byproduct, local accelerations of the horizontal wind are also obtained, and from these the rates of vorticity and divergence production may also be computed. Two examples are presented in which the method was applied. The examples indicate that there may be typical vertical motion, vorticity production, and divergence production fields associated with thunderstorms and tornadoes. The method can be machine programed for operational use in short range forecast problems. Author

N64-27428 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NASA 4.81 GG Meteorological Data Report
Marjorie E. Mc Lardie Hoidale May 1964 45 p refs
(ERDA-144; AD-444489)

Meteorological data gathered for the launching of Aerobee NASA 4.81 GG are presented along with calculated ballistic data. Author

N64-27429 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NASA 4.86 NA Meteorological Data Report
Marjorie Mc Lardie Hoidale May 1964 45 p refs For abstract see N64-27428 19-21
(ERDA-145; AD-444490)

N64-27430 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NASA 4.113 GA-GI, S/N NASA 97 Meteorological Data Report
Marjorie Mc Lardie Hoidale May 1964 45 p refs For abstract see N64-27428 19-21
(ERDA-146; AD-444491)

N64-27431 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NE 3.154 (NRL-88) Meteorological Data Report
Marjorie Mc Lardie Hoidale Jun. 1964 41 p refs For abstract see N64-27428 19-21
(ERDA-147; AD-444415)

N64-27434 Physikalisch-Meteorologisches Observatorium, Davos (Switzerland)
INVESTIGATION ON THE INFLUENCE OF CLOUDS ON ULTRAVIOLET SKY RADIATION (AT 330 mμ AND 370 mμ Technical Note No. 3
Paul Bener Mar. 1964 54 p refs
(Contract AF 61(052)-618)
(AFCRL-64-565; AD-603725)

The spectral intensity of ultraviolet radiation from the cloudless and the cloudy sky has been measured for $\lambda = 330$ mμ and 370 mμ at Davos (Swiss Alps, 1590 m a.s.l.). The ratio q between the intensities obtained with and without clouds and the scatter of these ratios are discussed and represented in diagrams for various cloud conditions and solar altitudes. The ratio q depends strongly on the thickness and density (optical thickness) of the cloud layer. Values between 2.05 (for Cs neb 10) and 0.06 (sky overcast with thunder clouds) have been found for $\lambda = 330$ mμ. Mean ratios $\bar{q}$ averaged over intervals of $\Delta h = 10°$ of solar altitude have been determined for the winter period (ground covered with snow) and the summer period (no snow cover). The mean ratios $\bar{q}$ and $\bar{q}$ obtained for $\lambda = 330$ mμ and 370 mμ are much smaller than those found in a former investigation for total sky radiation, which result indicates that the influence of clouds on sky radiation increases from the ultraviolet to the visible region. Author

N64-27531 McGill U., Montreal (Canada)
THE GREENHOUSE EFFECT OF THE ARCTIC ATMOSPHERE Scientific Report No. 11
E. Vowinckel Jul. 1964 20 p refs *Its* Publ. in Meteorology No. 67
(Contract AF 19(604)-7415)
(AFCRL-64-495; AD-603034)

The atmosphere is nearly transparent for solar radiation, but most of the terrestrial radiation is trapped by water vapor, carbon dioxide, and clouds. Some of this absorbed heat is radiated back to the earth's surface. This process is generally called the "greenhouse effect" of the atmosphere. It can most conveniently be expressed as: $G_a = L_a\downarrow / L\uparrow$, which gives a shielding effect of the atmosphere, where $L_a\downarrow$ is the atmospheric downward long-wave radiation caused by absorption in the atmosphere of radiation from the ground, and $L\downarrow$ is long-wave radiation from the ground. The amount of $L\downarrow$ that is caused by nonradiative processes can be found from: $G_a = L_a\downarrow / L\downarrow$, where $L\downarrow$ is atmospheric (long wave) radiation to the surface. The effect of water vapor in trapping terrestrial radiation is the dominating influence on the direct loss of heat by radiation from ground to space under cloudless conditions. Water vapor alone can trap three-fourths of the terrestrial radiation. The values for the two ratios G_a and G_a are discussed. Both show very small geographical and temporal variations. Author

N64-27534 Imperial Coll. of Science and Tech., London (Gt. Brit.)
RESEARCH ON CHARACTERISTICS AND EFFECTS OF SEVERE STORMS Final Report
May 1964 15 p refs
(Contract AF 61(052)-254)
(AFCRL-64-531; AD-603085)

The report very briefly outlines the objectives and results of 5 years of cumulonimbus study, and provides a complete list of publications. The chief results of the work are as follows: (1) measurement of air drag and fallspeeds of artificial hailstones; (2) derivation of an empirical law of rime density and studies of internal structure of rime and hail; (3) establishment of a simple calibration procedure for meteorological radars; (4) measurement of radar reflectivity of perspex and ice spheres; discovery of strong effect of surface wetting; (5) collection of radar and other data on a severe hailstorm in unprecedented detail, leading to definition of new radar echo

features (wall, forward overhang, echo-free vault, dome); (6) a new dynamical model of cumulonimbus in which vertical wind shear and precipitation are essential features; and (7) a new theory of the growth of large hail, not calling upon special embryos. Author

N64-27564 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Environmental Sciences Directorate
METEOROLOGICAL ROCKET NETWORK DATA PROCESSING AND PUBLICATION
Edward C. Kinsloe Jul. 1964 63 p refs
(ERDA-152; AD-443863)

Measurements of wind, temperature, and density of the atmosphere between 30 and 80 km have been conducted in the North American area in a systematic program. These data have been acquired at missile range sites by a number of cooperating governmental agencies in the pursuit of their particular research programs. A comprehensive program for the assimilation, processing, and publication of the acquired data has been devised and implemented to assure availability of the information in a uniform format for immediate study by atmospheric scientists. Author

N64-27701 Giannini Controls Corp., Duarte, Calif.
X-RAY AIR DENSITY DETERMINATION (X-RADD) Final Report, May 1963–Feb. 1964
Donald L. Johnson May 1964 89 p
(Contract AF 33(657)-11631)
(FDL-TDR-64-29; AD-601015)

This report describes the theoretical analyses, component selection, subsystem integration and tests of a breadboard system used to measure air density by scattering X-rays from air molecules. This technique provides a direct means of measuring air density. The eventual application is density measurement for energy management of reentry vehicles. Upon reentry, with the increase in air density there is a corresponding increase in the number of backscattered X-ray photons. The breadboard system was tested in a 41-ft-diam altitude sphere. Altitudes from sea level to 200,000 ft were simulated. The results of the test indicate that this technique is indeed useful for this application. Problem areas were uncovered, and, using the experience and components available, development of a flyable system can now be accomplished. An excellent testbed for a flyable system is the X-15 aircraft. Author

N64-27744 Air Force Cambridge Research Labs., Bedford, Mass.
INDICATIONS OF A LUNAR SYNODICAL PERIOD IN THE SUNSHINE OBSERVATIONS FOR BOSTON, MASSACHUSETTS, AND COLUMBIA, MISSOURI
Iver A. Lund Mar. 1964 15 p refs *Its* Environmental Res. Papers No. 9
(AFCRL-64-150; AD-601142)

An analysis of 25,201 days of sunshine observations at Boston, Mass., and 21,184 days of observations at Columbia, Missouri, shows that below average sunshine is observed between new moon and first quarter and between full moon and last quarter, whereas above average sunshine occurs between first quarter and full moon and between last quarter and new moon. Data from other stations will be studied to determine whether similar departures are observed at other locations. Author

N64-27794 Army Electronics Research and Development Activity, Fort Huachuca, Ariz. Meteorology Dept.
MICROMETEOROLOGICAL RESEARCH PROGRAM Progress Report, 1963
May 1964 35 p refs
(ERDAA-MET-4-64; AD-601032)

This report outlines U.S. Army micrometeorological research projects to improve the state-of-the-science so that satisfactory applications can be made in support of CBR warfare, rocket launching, and employment of combat surveillance sensors. These projects include a boundary-layer wind model, airflow in a vegetative canopy, solution of a parabolic differential equation, application of analog techniques to diffusion from boundary-layer models, some characteristics of the probability distribution of velocity and temperature distributions, and a new approach to the numerical solution of wind spirals. G.D.B.

N64-27865 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Environmental Sciences Directorate
STRATOSPHERIC SOLAR RESPONSE
Willis L. Webb Jul. 1964 28 p refs
(ERDA-156; AD-602958)

Analysis of stratospheric soundings obtained during the first four years of the Meteorological Rocket Network's exploration has provided new insight into the dynamics of stratospheric circulation. The data indicate that the winter storm period from mid-December to mid-February results from interaction between the opposing circulations of the winter and summer hemispheres. Initiation of these disturbances occurs in low latitudes of the winter hemisphere when the summer hemisphere circulation reaches its peak and actively invades the winter hemisphere. These disturbances propagate only toward the winter pole and act as an effective brake on the development of the winter westerly circulation. Except for this very pronounced period of dynamic interchanges, the stratosphere is found to respond systematically to changes in solar heat input. Author

N64-27866 Army Electronics Research and Development Activity, White Sands Missile Range, N.Mex. Environmental Sciences Directorate
OROGRAPHIC EFFECTS ON WIND VARIABILITY
James D. Horn and Elmer J. Trawle Jul. 1964 24 p refs
(ERDA-157; AD-602959)

One aspect of investigating the wind structure of the Tularosa Basin is the examination of the effects of nearby mountain ranges on perturbations in the wind field. Charts of standard deviation of low-level wind speed and direction as a function of mean wind speed and mean wind direction have been analyzed. A relation between these values and terrain features such as canyons and mountain barriers is suggested. Author

22 NAVIGATION AND GUIDANCE

Includes autopilots; star tracking; inertial platforms; and air traffic control. *For related information see*: 06 Auxiliary Systems; 08 Communications; 09 Electronics; 10 Facilities, Research and Support; 15 Instrumentation and Photography; 20 Mathematics; and 29 Space Sciences.

N64-27240* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

SPACE VEHICLE GUIDANCE—A BOUNDARY VALUE FORMULATION

Robert W. Hunt and Robert Silber 8 Jun. 1964 56 p refs (NASA-TM-X-53059) OTS: $5.60 ph

A mathematical formulation of the problem of guiding one stage of a space vehicle is given as a boundary-value problem in differential equations. One approach to the solution of this problem is to generate the Taylor's series expansion (in several variables) about a known solution. The theoretical nature of such solutions is discussed, and a method for numerically computing them is presented. This method entails the numerical integration of an associated system of differential equations and can be used to obtain the solution to any desired degree of accuracy for points in a region to be defined. An extension of the method to the problem of guiding several stages of a space vehicle is also given, employing fundamental composite function theory. Author

N64-27316* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

HORIZON SENSING FOR ATTITUDE DETERMINATION

Barbara Kegerreis Lunde Mar. 1962 19 p Presented at the AAS Goddard Memorial Symp., Wash., D.C., 16–17 Mar. 1962 (NASA-TM-X-51826; Rept.-62-47) OTS: $1.60 ph

Horizon sensing for attitude determination is discussed in terms of physical phenomena that may be used to define the horizon—infrared radiation from the earth, albedo from the earth, airglow around the earth, and other bodies; scanning schemes—passive scan, conical scan, linear scan, nutating scan, and illumination comparison; programs that use horizon scanning; and horizon scanning accuracy. G.D.B.

N64-27471 Aerospace Corp., El Segundo, Calif. Electronics Div.

A BOOST GUIDANCE SCHEME FOR FOLLOWING A TRAJECTORY PROFILE AND SATISFYING INJECTION CONSTRAINTS

P. R. Schultz, R. V. Soufl, and Carl Grubin 30 Jun. 1964 60 p refs

(Contract AF 04(695)-269)

(SSD-TDR-64-119; TDR-269(4540-70)-3; AD-603234)

Presented in this paper is a guidance philosophy that is useful for rocket booster missions that have complex specifications on injection conditions together with a requirement for closely following a given trajectory profile. The steering philosophy involves the use of position and/or velocity profiles that are functions of current speed in the initial stages of flight and "time-to-go" until the desired injection speed is attained in the final stage of powered flight. This type of guidance philosophy makes it possible to satisfy constraints on altitude, flight path angle, speed, orbital inclination, and angle-of-attack at injection. Both the preflight computations on the ground and the airborne computations can be accomplished with a reasonable effort. The main contribution of this paper involves pitch and yaw steering computations. The application of this philosophy to representative injection guidance problems is discussed. Author

N64-27648 Philco Corp., Palo Alto, Calif. Western Development Labs.

THE APPLICATION OF STATE SPACE METHODS TO NAVIGATION PROBLEMS

Stanley F. Schmidt Jul. 1964 111 p refs

(TR-4)

Mathematical concepts and examples are presented that have proven useful in resolving navigation problems whose description requires matrix methods because of the large number of states involved in their solution. Examples of nominal trajectories, equations and notations of motion, guidance laws for fixed and variable times of arrival and for minimum midcourse maneuver, error analysis, determination of state, and estimation of unknown parameters are considered. The principles of linear differential equations and their solution by state space methods are included in the appendix. M.P.G.

N64-27674* Martin Co., Baltimore, Md.

TWO-BODY MIDCOURSE NAVIGATION AND GUIDANCE FOR LUNAR MISSIONS

Donald H. Novak N.Y., AIAA [1964] 16 p refs Presented at the AIAA/Ion Astrodynamics Guidance and Control Conf. Los Angeles, 24–26 Aug. 1964

(Contract NAS1-2501)

(AIAA Paper-64-649) AIAA: $0.50 members; $1.00 nonmembers

It is feasible to navigate and guide in cislunar space by means of the two-body equations with high accuracy and reasonable fuel expenditure. The two-body trajectory was computed from simple forms in rectangular coordinates with respect to an appropriate virtual mass fixed on the earth–moon line to replace the combined effects of earth and moon. For each guidance and navigation situation in midcourse, the virtual mass location compensates for the out-of-plane distortion of the actual integrated trajectory from one point to another, and the mass magnitude corrects for the in-plane deviation. On final approach to either earth or moon, there is relatively little planar distortion; hence, the virtual mass is located at the center of the target body, and the magnitude is adjusted to correct for the in-plane variation in the actual pericenter radius. The virtual mass data were computed for many guidance and navigation situations on each trajectory of a set of specially parameterized, integrated, restricted three-body circumlunar trajectories. Author

N64-27675* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

A STUDY OF THE NAVIGATOR'S SIGHTING ACCURACY USING A SIMULATED VEHICLE-MOUNTED SPACE SEXTANT AND A DESCRIPTION OF THE SEXTANT SIMULATOR

Richard L. Kurkowski and Kenneth C. Grover N.Y., AIAA [1964] 16 p refs Presented at the AIAA/Ion Astrodyn. Guidance and Control Conf., Los Angeles, 24–26 Aug. 1964 (AIAA Paper-64-651) AIAA: $0.50 members, $1.00 nonmembers

The midcourse guidance system for manned space missions may require a navigator to measure accurately with optical instruments angles between various planets, the moon, and stars. One instrument proposed for this purpose is a sextant mounted in the space vehicles structure. The operation and performance of such a system have been investigated with a fixed-cockpit, analog-computer simulation. To obtain a sighting accuracy of ±2 arcsec (standard deviation) with a conventional analog computer and cathode ray tube display, it was necessary to derive a mathematical model (second-order perturbation angle techniques) that could resolve the angular relationships to within 1 arcsec on the analog computer. A description is given of this space-sextant simulator. In this simulation an evaluation was made of the effects of line-of-sight motion, vehicle motion, and operator technique on the measurement accuracy of the navigator–sextant combination for several specific operating conditions.

Sighting time and amount of fuel used were also measured. The results of the study indicate that the space-sextant–navigator system can effectively provide the accurate sighting information required for manned space flight navigation. Author

N64-27754* Massachusetts Inst. of Tech., Cambridge Experimental Astonomy Lab.
A GUIDANCE-NAVIGATION SEPARATION THEOREM
James E. Potter N.Y., AIAA [1964] 14 p refs Presented at the AIAA/ION Astrodyn. Guidance and Control Conf., Los Angeles, 24–26 Aug. 1964
(Grant NsG-254-62)
(AIAA-Paper-64-653) AIAA: $0.50 members, $1.00 nonmembers

A trajectory control system for a space vehicle may be divided into two subsystems: (1) the navigation subsystem that filters noisy navigation measurements in order to generate estimates of the vehicle's position, velocity, and mass; and (2) the guidance subsystem that uses this information to generate commands for the vehicle propulsion system in order to accomplish the assigned mission with a minimum cost. Generally, in order to obtain an optimum control system it is necessary to coordinate the design of the two subsystems so that the guidance subsystem is as insensitive as possible to the expected navigation errors and the type of errors produced by the navigation subsystem has the least effect on guidance. However, in the somewhat idealized case when the vehicle dynamical equations are linear and the cost function is quadratic, the separation theorem states that the optimum control system is obtained when the guidance and navigation subsystems are designed separately without considering their interaction. This result was obtained for sampled data control systems and is extended to continuous time control systems. Author

N64-27755* Hughes Aircraft Co., El Segundo, Calif.
MIDCOURSE GUIDANCE EQUATIONS FOR THE SURVEYOR SPACECRAFT
C. M. Meredith and R. K. Cheng N.Y., AIAA [1964] 16 p refs Presented at the AIAA/Ion Astrodyn. Guidance and Control Conf., Los Angeles, 24–26 Aug. 1964
(Contract SNAS7-100; JPL-950056)
(AIAA-Paper-64-654) AIAA: $0.50 members, $1.00 nonmembers

This paper contains a discussion of the midcourse guidance logic that has been developed to compute, in real time, the required midcourse maneuver that will correct the landing site dispersions at the moon due to injection guidance errors. The maneuver is determined so that in addition to correcting the "miss at the moon," certain terminal constraints placed upon the main retro motor burnout velocity, the visibility from the Goldstone tracking station at arrival, and the minimum allowable fuel margin are satisfied. It is also shown that from a combined midcourse and terminal propellant standpoint the so-called critical plane maneuver is not the optimum. A component of the maneuver can be utilized to reduce both the unbraked impact velocity and the spacecraft weight. This in turn will reduce the propellant requirement for the terminal descent phase and, in certain instances, the overall requirement. Author

N64-27814* Serendipity Associates, Los Angeles, Calif.
PILOT ACCEPTANCE FACTORS RELATED TO INFORMATION REQUIREMENTS AND DISPLAY CONCEPTS FOR ALL-WEATHER LANDING
Richard A. Behan, Ewart E. Smith, and Harold E. Price Washington, NASA, 15 Jul. 1964 155 p refs
(Contract NAS2-1346)
(NASA-CR-58030) OTS: $11.50 ph

The present study was conducted to determine the information items pilots need to solve the landing problem, the units and accuracy requirements for this information, and acceptable ways of presenting the information. An additional purpose was to determine a minimum set of information items to be included in a windshield display of an aircraft simulator, to be used in an empirical determination of an adequate windshield display for all-weather landing. Author

23 PHYSICS, GENERAL

Includes acoustics; cyrogenics; and optics. *For astrophysics see*: 05 Astronomy and Astrophysics. *For related information see*: 12 Geophysics; 29 Space Sciences; 24 Physics, Plasma; and 25 Physics, Solid-State.

N64-26995 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
JOURNAL OF TECHNICAL PHYSICS Selected Articles
3 Jun. 1964 29 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 34, no. 2, 1964 p 354–368
(FTD-TT-64-380/1+2+4; AD-601564)

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2. INVESTIGATION OF THE ENERGY DISTRIBUTION OF NICKEL ATOMS DURING CATHODE SPUTTERING OF NICKEL BY MERCURY IONS M. B. Ben'yaminovich and V. I. Veksler p 13–26 refs (See N64-26997 19-23)

N64-26997 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INVESTIGATION OF THE ENERGY DISTRIBUTION OF NICKEL ATOMS DURING CATHODE SPUTTERING OF NICKEL BY MERCURY IONS
M. B. Ben'yaminovich and V. I. Veksler *In its* J. of Tech. Phys. 3 Jun. 1964 p 13–26 refs (See N64-26995 19-23)

To investigate energy distribution, a stream of neutral particles is passed through a mercury arc plasma of low pressure, and the resulting ions are subjected to analysis. A neutral atom stream was investigated that was obtained as a result of bombarding nickel with mercury ions with an energy of 200 to 800 ev. An energy distribution was obtained for sputtered nickel in the energy region w > 10 ev. The relative quantity of fast atoms and the maximum energies grow as the energy of bombarded ions grows. The dependence of the stream of sputtered particles on the temperature of the target was investigated. Author

N64-27000 Physics, Engineering, Chemistry Corp., Boulder, Colo.
MATHEMATICAL APPENDIX
Robert G. Kuller *In its* Investigation of the Dynamics of Ionized Media (Plasmas) May 1964 p 162–185 refs (See N64-26998 19-24)

Details of the mathematical aspects of using functionals to study the statistical mechanics of fields are presented. Precise definitions of mathematical objects entering into the theory, and careful statements of the mathematical results employed are given. Results indicated that using the integration procedure of Friedericks, Shapiro, et al, is not suitable for the treatment of statistical mechanics problems. The Wiener method of integrating functions on spaces of continuous functions is suggested. R.T.K.

N64-27001 Gt. Brit. Ministry of Aviation, Mottingham Technical Information and Library Services
NOISE BIBLIOGRAPHY, VOL. 3
Jun. 1964 24 p refs
(TIL/BIB/73/Vol. 3)

An annotated bibliography on noise is presented. The majority of the documents included are directly allied to aircraft noise, either in theory or practice. A publisher and author index is presented. J.L.C.

N64-27035 California U., Livermore Lawrence Radiation Lab.
A NEW DERIVATION OF MULTIGROUP CROSS SECTIONS FOR BeO- AND GRAPHITE-MODERATED SYSTEMS
R. J. Doyas and E. H. Canfield 28 Apr. 1964 77 p refs
(Contract W-7405-ENG-48)
(UCRL-7827) OTS: $1.75

Multigroup diffusion equation cross sections are rederived using updated numerical techniques and recent basic cross-section measurements. The basic series of Spade (BeO-moderated) and Snoopy (graphite-moderated) critical assemblies are calculated using these group constants, and the results are compared with those from earlier compilations. Author

N64-27043 California U., Livermore Lawrence Radiation Lab.
THE POLARIZATION OF NEUTRONS FROM THE $C^{13}(p,n_0)N^{13}$ AND $N^{15}(p,n_0)O^{15}$ REACTIONS
Bryan Dale Walker (Ph.D. Thesis) 1 Jun. 1964 62 p refs
(Contract W-7405-ENG-48)
(UCRL-7676) OTS: $1.50

The polarizations of neutrons from the $C^{13}(p,n_0)N^{13}$ and $N^{15}(p,n_0)O^{15}$ reactions were measured for several proton energies in the region between 6.9 and 12.3 Mev and neutron emission angles between 0 and 90°. The neutrons were detected using a time-of-flight facility incorporating pulse-shape discrimination to reduce the time-independent background. The left and right measurements were obtained by employing a solenoid for spin precession. Liquid helium was utilized as an analyzer. Large polarizations (50% to 70%) were noted for both reactions at several energies and angles. Corrections for multiple scattering in the analyzer were made. The energy dependence of the polarizations tends to confirm the twin reaction hypothesis of Bloom *et al*. Comparisons with polarization predictions of the quasi-elastic model of the (p,n) process are also shown. Author

N64-27086 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PROCEEDINGS OF THE ALL-UNION CONFERENCE ON THEORETICAL AND APPLIED MECHANICS
L. I. Sedov, ed. 18 May 1964 743 p refs Transl. into ENGLISH of the book "Trudy Vsesoyuznogo S'yezda po Teoreticheskoy i Prikladnoy Mekhanike" Moscow, Izd. Akad. Nauk SSSR, 1962 p 1–468 Conf. held in Moscow, 27 Jan.–3 Feb. 1960
(FTD-TT-63-471/1+2; AD-602320)

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N64-27196 Centre National de la Recherche Scientifique, Bellevue (France)

THE PERTURBATION OF SPECTRAL FREQUENCIES BY SOLID MATRICES Quarterly Technical Status Report, Apr. 1–Jun. 30, 1963

B. Vodar [1963] 5 p

(Contract DA-91-591-EUC-2882)

(QTSR-1; AD-437644)

Results are reported of experiments on spectral absorption of pure xenon, xenon in crystalline krypton, and xenon in crystalline argon. Displacements of absorption bands in the vacuum ultraviolet region are noted, and electron structures are discussed. Instrumentation is briefly described. D.E.W.

N64-27219 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France)

A POSSIBLE EXPLANATION FOR THE EXPONENTIAL DAMPING OF LARGE TRANSVERSE MOMENTA OF PARTICLES PRODUCED IN HIGH ENERGY COLLISIONS

P. Dennery and A. Krzywicki Jun. 1964 23 p refs

(TH-58)

It is suggested that the existence of vector bosons coupled to conserved currents and the independence of emission of secondaries in multiple production processes may together explain the observed exponential shape of the transverse-momentum distributions of particles produced in high-energy collisions. Author

N64-27223 Innsbruck U. (Austria)

THE CONSERVATION LAW OF ANGULAR MOMENTUM IN GENERAL RELATIVITY Special Scientific Report No. 10

P. Unteregger 13 Jul. 1964 15 p refs

(Contract DA-91-591-EUC-2682)

Subjects of discussion include gravitational energy, weak and strong laws of conservation, superpotentials, derivation of the conservation law of angular momentum without considering spin, derivation of the conservation law of angular momentum by the method of superpotentials, and derivation of the conservation law of angular momentum for the electron gravitational field with spin in general relativity. D.E.W.

N64-27233 Stanford U., Calif. Microwave Lab.

A STUDY OF OPTICAL TRANSITION PROBABILITIES AND METHODS OF MODULATING THEM Semi-Annual Progress Report, 1 Oct. 1962–31 Mar. 1963

A. L. Schawlow, W. Moos, W. M. Yen, and G. F. Imbusch May 1963 4 p

(Grant DA-ARO(D)-31-124-G326)

(ML-1036; AD-437874)

A qualitative theoretical investigation was made of the effects of a strong a.c. electric field that was applied along the [100], [110], and [111] directions, to a MgO crystal with included chromium ions. Harmonics of the 200-cps excitation voltage and noise were only partially excluded from the measurements. However, the fluorescence was too weak and too well masked by other signals to be detected. The effects of thermal lattice vibrations on the sharp lines of the Cr^{3+} and V^{2+} ions in MgO were also examined. D.E.W.

N64-27234 Stanford U., Calif. Microwave Lab.

A STUDY OF OPTICAL TRANSITION PROBABILITIES AND METHODS OF MODULATING THEM Semi-Annual Progress Report, 1 May–30 Sep. 1962

A. L. Schawlow, W. Moos, W. M. Yen, and G. F. Imbusch Oct. 1962 4 p

(Grant DA-ARO(D)-31-124-G326)

(ML-973; AD-437873)

The influence of symmetry on optical selection rules was investigated. The possibility of changing line intensity by applying an electric field to reduce the symmetry was examined. The initial studies were concerned with Cr^{3+} ions in magnesium oxide, and specifically those Cr^{3+} ions that replace Mg^{2+} ions and enter cubic sites. It was found that these ions give rise to a sharp optical transition at 6,981 A, which occurs by magnetic dipole radiation and is quite weak. R.T.K.

N64-27255* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

AN ALGORITHM FOR THE COORDINATES OF VINTI'S ZONAL HARMONIC PERTURBATIONS OF AN REFERENCE ORBIT

N. L. Bonavito Mar. 1964 13 p refs

(NASA-TM-X-55021; X-547-64-65) OTS: $1.60 ph

The procedure developed in an earlier paper for the computation of coordinates for Vinti's accurate reference orbit is slightly extended to include his treatment of the zonal harmonic perturbations of the reference orbit. Herein is discussed the method for obtaining the position and velocity coordinates due to the more important part of the residual potential. Author

N64-27293 Catholic U. of America, Washington, D.C.

THE APPLICATION OF MOLECULAR ORBITALS TO THE STUDY OF SIMPLE MULTI-ATOMIC SYSTEMS Final Report, 1 Jun. 1953–31 Oct. 1963

Virginia Griffing [1963] 85 p refs

(Contract Nonr-1220(00))

(AD-435425)

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1. INTRODUCTION, COMPUTATIONAL PROCEDURE, AND RESEARCH PROJECTS IN THE APPLICATION OF MOLECULAR ORBITALS TO THE STUDY OF SIMPLE MULTI-ATOMIC SYSTEMS 52 p refs (See N64-27294 19-23)

APPENDIX A

2. IMPROVEMENT OF A LCAO-MO-SCF ELECTRONIC WAVE FUNCTION FOR BE_2 BY CONFIGURATION INTERACTION 13 p refs (See N64-27295 19-23)

APPENDIX B

3. IMPROVEMENT OF THE LCAO-MO-SCF ELECTRONIC WAVE FUNCTION OF C_2 BY CONFIGURATION INTERACTION 20 p refs (See N64-27296 19-23)

N64-27294 Catholic U. of America, Washington, D.C.

[INTRODUCTION, COMPUTATIONAL PROCEDURE, AND RESEARCH PROJECTS IN THE APPLICATION OF MOLECULAR ORBITALS TO THE STUDY OF SIMPLE MULTI-ATOMIC SYSTEMS]

Virginia Griffing *In its* The Appl. of Mol. Orbitals to the Study of Simple Multi-Atomic Systems [1963] 52 p refs (See N64-27293 19-23)

Following a brief discussion of research aims and computational methods used, summaries of published papers on the following topics are given: (1) the fundamental assumptions regarding the *a priori* value of the molecular orbital method in obtaining qualitative information about the chemical kinetics of interacting molecules; (2) application of these considerations to the H_4 complex intermediate in the reaction of two H_2 molecules, the hydrogen–halogen reactions, the linear H_3 complex, and the interaction of Be and H_2; (3) quantitative results for LCAO-MO-SCF studies of H_4, H_3, and H_2; and (4) LCAO-MO-SCF studies of NH, LiHe (LiHe$^+$ and LiHe$^-$), H_2^+, and H_2. Also included is recent, unpublished work directed toward minimizing the correlation error by means of a configuration interaction treatment based on LCAO-MO's for B_2, and the completed CI studies of the $^1\Sigma_g^+$ state of Be_2 and the $^1\Sigma_g^+$, $^3\Pi_u$, $^3\Sigma_g^-$, $^1\Pi_u$, $^3\Pi_g$, $^1\Pi_g$, and $^1\Sigma_u^+$ states of C_2. Author

N64-27295 Catholic U. of America, Washington, D.C.
IMPROVEMENT OF AN LCAO-MO-SCF ELECTRONIC WAVE-FUNCTION FOR Be_2 BY CONFIGURATION INTERACTION Appendix A
Virginia Griffing *In its* The Appl. of Mol. Orbitals to the Study of Simple Multi-Atomic Systems [1963] 13 p refs (See N64-27293 19-23)

An attempt was made to make maximum use of the basic set of AO (atomic orbitals), via exhaustive CI (configuration interaction) to describe the ground state and several excited states of Be_2. However, results were obtained only for the ground state. Tables are included that give the molecular energy of each degree of CI for each of seven chosen fixed internuclear distances. Information is presented that is based on the selection of configurations according to diagonal energy alone, as well as on both diagonal and off-diagonal magnitudes. R.T.K.

N64-27296 Catholic U. of America, Washington, D.C.
IMPROVEMENT OF THE LCAO-MO-SCF ELECTRONIC WAVE FUNCTION OF C_2 BY CONFIGURATION INTERACTION Appendix B
Virginia Griffing *In its* The Appl. of Mol. Orbitals to the Study of Simple Multi-Atomic Systems [1963] 20 p refs (See N64-27293 19-23)

The SCF results are presented as tables. The screening constants are best atom values for 1s and 2s, the latter being adopted as a convenience for 2p, 3s, and 3p. Of the 18 MO, the 10 least energetic were used for CI. Since empirically derived potential curves for seven Σ and Π states of C_2 were available, extensive CI was carried out on these seven states, for seven fixed internuclear separations, R, to provide potential curves for comparison. A table gives the configurations, chosen according to diagonal energy only, for each state. Another table gives the molecular energy E_M for each degree of CI and each R value. The lower half of this table gives the results simultaneously obtained for the second lowest root of the CI, corresponding to the state $e^1\Sigma_g^+$. To evaluate the shape of the lowest $^1\Sigma_g^+$ potential curve, a Morse curve was fitted to the seven points (E_M, R); results are given in a table. CI for all seven states is summarized in one of the tables. A table compares computed with experimentally derived values for all seven states. Author

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N64-27322 Joint Publications Research Service, Washington, D.C.
THE 600-KILOVOLT ELECTROSTATIC ACCELERATOR AT THE SCHOOL OF ENGINEERING IN SPLIT
Nikola Cindro 31 Jul. 1964 12 p Transl. into ENGLISH from Tehnika (Belgrade), no. 6, Jun. 1964 p 101–1014
(JPRS-25692; TT-64-31964) OTS: $1.00

The article presents the working principles and technical characteristics of an electrostatic Van de Graaff 600-kv accelerator built in Yugoslavia. The basic technical specifications are maximum voltage of the source—650 kv, stream of deuterons on the target—more than 50μ A, and a beam diameter on the target—3 nm Φ. The device will be used for studying nuclear reactions caused by energy particles of less than 1 Mev and for the production of neutrons and high energy gamma rays. It will also be used for studying the effect of electron ionizing radiation on the properties of polymers. A source of electrons will be installed for this purpose. Author

N64-27365* National Aeronautics and Space Administration, Washington, D.C.
ON THE MOTION OF CERTAIN MECHANICAL SYSTEMS WITH VARIABLE MASSES [O DVIZHENII NEKOTORYKH MEKHANICHESKIKH SISTEM S PEREMENNYMI MASSAMI]
V. F. Yakovlev Jul. 1964 10 p refs Transl. into ENGLISH from Izv. Akad Nauk SSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 5, 1963 p 198–202
(NASA-TT-F-8742)

Mechanical systems with variable masses subordinated to both ideal and nonideal conditions (of the servoconnection type) have been examined. In the case of such systems it is assumed that the possible displacements permissible by the ideal connections include definitive displacements that are not affected by the reaction of nonideal connections. The Euler–Lagrange principle applies to the reviewed systems, and equations of motion in various forms have been developed. Some problems involving the mechanics of the changing body of a variable mass have been examined on the basis of these results. A study has been made, in particular, of the structural continuity of that changing body, that has facilitated an examination of the problem of the motion of a homogeneous burning sphere in a very rough plane. Author

N64-27381* Geophysics Corp. of America, Bedford, Mass.
PLANETARY PHYSICS. IV: AN EXPANSION METHOD FOR CALCULATING ATOMIC PROPERTIES. I: THE ^2S AND $^2P^0$ STATES OF THE LITHIUM SEQUENCE
M. Cohen and A. Dalgarno [1964] 31 p refs
(Contract NASw-840)
(NASA-CR-57010; GCA-TR-64-5-N) OTS: $3.60 ph

An expansion method is used to calculate the expectation values of various operators for the lowest ^2S and $^2P^0$ states of all members of the lithium sequence. The method is extended to the calculation of matrix elements connecting the two states, and the electric dipole transition integrals are calculated. A comparison with the results of more refined calculations shows that despite its simplicity the method is capable of high accuracy. Author

N64-27386* Wisconsin U., Madison Theoretical Chemistry Inst.
COMPARISON OF THE HARTREE-FOCK ORBITAL WITH THE FIRST NATURAL SPIN ORBITAL FOR TWO-ELECTRON SYSTEMS Interim Technical Report, Sep. 1961–Apr. 1963
George V. Nazaroff and Joseph O. Hirschfelder Wright-Patterson AFB, Ohio, ARL, May 1963 20 p refs
(Grant NsG-275-62(4180); Contract AF 33(657)-7311)
(NASA-CR-56669; ARL-63-79) OTS: $1.60 ph

A demonstration is given that for two-electron systems the Hartree–Fock and first natural spin orbitals are different functions. The method used is the perturbation theory for which the zero-order problem is the Hartree–Fock approximation. A perturbation expansion through the second order is obtained for the first natural spin orbital. The two orbitals begin to differ in the second order and their energies in the fourth order. An equation for the second order part of the orbital difference function is derived. Estimates of the norms of the orbital difference functions are calculated for the ground states of the helium atom and the hydrogen molecule are found to be small. Author

N64-27392* Rensselaer Polytechnic Inst., Troy, N.Y.
GUIDANCE AND CONTROL SCHEMES FOR MANNED LUNAR LANDING
C. N. Shen [1964] 24 p refs
(Grant NsG-14-59)
(NASA-CR-58073)

The objective of this paper was to find feasible control schemes for descent trajectories that will give, with high accuracy, the final position and velocity for lunar landing. A stable control system can be provided for any initial error. With the aid of a feedback system obtained from measurements of the state of the vehicle, very small deviations from the programed course are expected, so that a bull's eye landing can be achieved. The variational equations given are completely general in scope for any two-dimensional problem provided the vehicle is not coasting. By choosing the computer scheme and the nonlinear guidance for specific forces a_θ and a_r, the angular and radial errors are constants and the velocity errors are zero if the system starts with the specific perturbed initial conditions. The solution for the reference trajectory is in algebraic closed form, which simplifies the computational aspect of the control, either by manual or automatic operation. Author

N64-27415 Weapons Research Establishment (Australia)
SOME SUB-PROGRAMMES FOR USE IN OPTICAL SYSTEM RAY TRACINO, USING THE IBM 7090 COMPUTER
B. Porter May 1964 17 p refs
(WRE-TN-CPD-80)

A description is given of the use and operation of various subprograms that have been compiled and successfully used, in a specific optical design project. Some knowledge of FORTRAN is assumed. The subprograms may be divided into three groups, as follows: (1) computation of surface coefficients; (2) ray tracing at interfaces; and (3) detection of minimum focus. Author

N64-27418 Wisconsin U., Madison Theoretical Chemistry Inst.
QUANTUM CORRECTIONS TO THE TRANSPORT CROSS-SECTIONS
Herbert T. Wood and C. F. Curtiss 26 Mar. 1964 32 p refs
(Sponsored by NSF)
(WIS-TCI-34A; AD-600071)

By a method developed earlier, the second quantum correction to the phase shift in a collision between particles with spherically symmetric potentials is obtained. This expression, along with the classical limit and the first quantum correction developed earlier, is used to obtain the classical limit and the first and second quantum corrections to the cross sections $Q^{(1)}$ and $Q^{(2)}$. In these expressions the potential function is not restricted to monotonic functions; the results apply to a potential with an attractive minimum. Author

N64-27436 Air Force Cambridge Research Labs., Bedford, Mass.
A GEOMETRIC STUDY OF COHERENCE PROPERTIES OF PARTIALLY POLARIZED ELECTROMAGNETIC RADIATION
E. Folke Bolinder Jun. 1964 25 p refs Presented at the 6th Congr. of the Intern. Comm. for Optics, Munich, 19-26 Aug. 1962 *Its* Phys. Sci. Res. Papers No. 24
(AFCRL-64-460; AD-603588)

The well-known analytic theory of partially polarized electromagnetic waves is complemented with a geometric theory. In the geometeric theory the components of the 2 × 2 coherence matrix of a partially polarized plane wave and the Stokes parameters of the wave are treated in two four-dimensional spaces. From the first four-dimensional space a three-dimensional space is derived, which constitutes a Poincaré model of three-dimensional (non-Euclidean) hyperbolic space having a plane—the polarization ratio plane—as the fundamental surface. This model can also be obtained by a generalization to three dimensions of an elementary inversion method called the isometric circle method in the polarization ratio plane. A cross section through the second four-dimensional space, which is a Minkowski model of Lorentz space, yields the Cayley–Klein model of three-dimensional hyperbolic space having the unit sphere, in optics called the Poincaré sphere, as fundamental surface. Invariant properties of partially polarized waves are studied by means of the different models. So, for example, transformations of the complex degree of correlation μ and the degree of polarization P (defined as the ratio of the polarized intensity and the total intensity) are studied in the Poincaré and Cayley–Klein models by means of simple geometric constructions that lucidly show the relationships between the degree of correlation and the degree of polarization. Author

N64-27453 Technische Hochschule Darmstadt (W. Germany) Inst. für Meteorologie
ON THE TWO-DIMENSIONAL SPECTRAL ANALYSIS OF KINETIC ENERGY OVER A CIRCUMPOLAR AREA OF A SPHERE Technical Note No. 5
F. Mesinger 31 Dec. 1963 40 p refs
(Contract AF 61(052)-366)
(AFCRL-64-248; AD-603729)

Two possibilities for the two-dimensional spectral analysis of kinetic energy of flow fields (on spherical earth) are discussed, one using the associated Legendre polynomials for meridional representation, and the other the sine functions with a latitude-dependent amplitude factor. The latter method is applied to the analysis of some 500 mb observed and barotropically predicted wind fields. The obtained two-dimensional and resulting one-dimensional spectral distributions are described. A fair similarity is observed between the meridional spectra of zonal motion and zonal spectra of meridional motion, and between the meridional spectra of meridional motion and zonal spectra of zonal motion. Differences in time variations of observed and predicted spectra are treated. Author

N64-27462 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
NEWS OF THE ACADEMY OF SCIENCES OF THE USSR, TECHNOLOGY SECTION, MECHANICS AND MACHINE BUILDING Selected Articles
V. I. Sergeyev and M. I. Subbotin 26 May 1964 19 p refs Transl. into ENGLISH of 2 articles from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 3, 1963 p 149–152, 153–155
(FTD-64-415/1+2+4; AD-601507)

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2. ON THE PRECISION OF RECORDING PULSED ACCELERATIONS M. I. Subbotin p 11–16 refs (See N64-27464 19-23)

N64-27463 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

SOME GENERAL PROBLEMS IN CORRELATION ANALYSIS OF MECHANISM PRECISION

V. I. Sergeyev *In its* News of the Acad. of Sci. of the USSR, Technol. Sect., Mech. and Machine Building 26 May 1964 p 1–10 refs (See N64-27462 19-23)

Emphasis in this report is placed on an analysis of the precision of a group of mechanisms from a single design, which corresponds to their mass (serial) production. Equations are derived that illustrate the advantage of a correlation analysis of mechanism precision over that of a variance analysis.

I.v.L.

N64-27464 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.

ON THE PRECISION OF RECORDING PULSED ACCELERATIONS

M. I. Subbotin *In its* News of the Acad. of Sci. of the USSR, Technol. Sect., Mech. and Machine Building 26 May 1964 p 11–16 refs (See N64-27462 19-23)

Sine and sine-squared pulses $f_1(t) = \sin \pi t/T + \sin (\pi t/T - \pi)$ and $f_2(t) = \sin^2 \pi t/T - \pi)$, respectively, were investigated, where T is the pulse duration, and all arguments are greater than zero. These pulses are sufficiently close in shape and acceleration to those that arise on the collision of convex bodies, the first of them beginning more abruptly, and the second more smoothly. The problem of the recording process is reduced to the solution of the accelerometer equation with the right side of the indicated shapes subjected to various values of T_0/R (T_0 being the period of free oscillations of the accelerometer) and of the damping factor D. I.v.L.

N64-27469 Aerospace Corp., El Segundo, Calif.

INVESTIGATION OF THE DYNAMIC STABILITY OF A ROD

V. I. Weingarten 28 Feb. 1964 36 p refs

(Contract AF 04(695)-269)

(SSD-TDR-64-21; TDR-269(4560-40)-3; AD-603494)

The dynamic stability of a simply supported and clamped rod is investigated experimentally. Results indicate that large amplitude vibrations can be obtained in secondary regions of instability, as well as in the principal region. Author

N64-27474 School of Aerospace Medicine, Brooks AFB, Tex.

SCATTERED RADIATION FROM A COBALT-60 SOURCE IN A BRICK STRUCTURE

Roger W. Cochran Jun. 1964 7 p refs

(SAM-TDR-64-14; AD-603051)

A determination was made of the scattered component of cobalt-60 radiation produced in a brick structure. An end-window scintillation detector, connected to a 400-channel, pulse-height analyzer, and associated readout equipment were utilized for this study. It was found that a scatter component of 2.7% to 12.4% of the emitted radiation was produced by the brick walls and concrete floor of the magnesium cell. The scatter component can be extremely significant where dosimeters with enhanced, low-energy responses are used. Author

N64-27500 Chalmers U. of Tech., Göteborg (Sweden) Research Lab. of Electronics

DYNAMIC NON-LINEAR WAVE PROPAGATION IN IONIZED MEDIA. 15: ČERENKOV EFFECT IN A PRE-OSCILLATING MEDIUM Research Report No. 46

K. H. B. Wilhelmsson and A. R. Thomasson 1 Apr. 1964 22 p refs

(Contract AF 61(052)-451)

(AFCRL-64-534; US-40; AD-602970)

The purpose of the present investigation is to show that for a preoscillating medium, i.e., a medium that oscillates in time and space even in the absence of a Čerenkov electron, sidebands of the original Čerenkov radiation spectrum will be generated, and to determine the characteristics of the associated waves. Author

N64-27517 Oak Ridge National Lab., Tenn. Neutron Physics Div.

CALCULATION OF FISSION-SOURCE THERMAL-NEUTRON DISTRIBUTION IN WATER BY THE TRANSFUSION METHOD

D. K. Trubey Aug. 1964 54 p refs

(Contract W-7405-ENG-26)

(ORNL-3487) OTS: $1.25

A calculational method that combines transport theory and diffusion theory, called the transfusion method, was used to obtain the thermal–neutron flux from a point isotropic fission source in water. The transport theory code RENUPAK, which utilizes the moments method, was used to calculate the energy-spatial neutron distribution above 1 kev, and the multigroup diffusion code MODRIC was used to continue the calculation down to thermal energies. The resulting thermal–neutron fluxes agree very well with experimental results for distances out to 70 cm from the source, but the calculated fluxes are as much as 40% higher for greater distances. Author

N64-27552 General Dynamics/Astronautics San Diego, Calif. Space Science Lab.

MOLECULAR BEAM STUDIES OF ATOMIC COLLISIONS Annual Report, 1 Apr. 1963–30 Jun. 1964

Roy H. Neynaber and Erhard W. Rothe 30 Jun. 1964 61 p refs

(Contract Nonr-3674(00))

(GDA-DBE-64-037; AD-442141)

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1. INTERACTION POTENTIALS FROM THE VELOCITY DEPENDENCE OF TOTAL ATOM-ATOM SCATTERING CROSS SECTIONS Erhard W. Rothe, P. K. Rol (Lab. for Mass-Separation, Amsterdam), and Richard B. Bernstein (Michigan U.) 6 p refs (See N64-27553 19-23)

2. SUBSTANTIATION OF A METHOD FOR OBTAINING INTERATOMIC POTENTIAL ENERGY PARAMETERS Erhard W. Rothe, R. H. Neynaber, Burton W. Scott, S. M. Trujillo, and P. K. Rol 2 p refs (See N64-27554 19-23)

3. LOW-ENERGY ELECTRON SCATTERING FROM METASTABLE HELIUM R. H. Neynaber, S. M. Trujillo, Lawrence L. Marino, and Erhard W. Rothe 14 p refs (See N64-27555 19-23)

4. INTERACTION POTENTIALS FROM THE VELOCITY DEPENDENCE OF TOTAL ATOM-ATOM SCATTERING CROSS SECTIONS Erhard W. Rothe, P. K. Rol, R. H. Neynaber, and S. M. Trujillo 14 p refs (See N64-27556 19-23)

5. VELOCITY DEPENDENCE OF THE TOTAL CROSS SECTION FOR THE SCATTERING OF METASTABLE $He(^3S_1)$ BY HELIUM, ARGON, AND KRYPTON Erhard W. Rothe, R. H. Neynaber, and S. M. Trujillo 22 p refs (See N64-27557 19-23)

N64-27553 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
INTERACTION POTENTIALS FROM THE VELOCITY DEPENDENCE OF TOTAL ATOM-ATOM SCATTERING CROSS SECTIONS
Erhard W. Rothe, P. K. Rol (Lab. for Mass-Separation, Amsterdam), and Richard B. Bernstein (Michigan U.) *In its* Mol. Beam Studies of Atomic Collisions 30 Jun. 1964 6 p refs Repr. from Phys. Rev., v. 130, no. 6, 15 Jun. 1963 p 2333–2338 (See N64-27552 19-23)

Methods are described that yield the interatomic potential energy parameters from the velocity (v) dependence of the total scattering cross section (Q). These are applied to previously reported measurements of the scattering of lithium by the rare gases. The Lennard–Jones (12,6) potential is assumed. The cross sections for scattering by argon, krypton, and xenon were measured in a "low-energy" region, where Q (v) is undulatory. From the extrema velocities the product $\epsilon\ \sigma$ may be obtained, where ϵ is the depth of the interatomic potential well and σ is the interatomic separation at the zero of potential energy. From the absolute value of Q, the parameter σ (and thus ϵ) may be determined separately. Author

N64-27554 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
SUBSTANTIATION OF A METHOD FOR OBTAINING INTERATOMIC POTENTIAL ENERGY PARAMETERS
Erhard W. Rothe, R. H. Neynaber, Burton W. Scott, S. M. Trujillo, and P. K. Rol *In its* Mol. Beam Studies of Atomic Collisions 30 Jun. 1964 2 p refs Repr. from J. Chem. Phys., v. 39, no. 2, 15 Jul. 1963 p 493–494 (See N64-27552 19-23)

A method has been described that yields the interatomic potential energy parameters from the velocity (v) dependence of the total scattering cross section (Q) (in a low-velocity region). It was previously applied to measurements of Q(v). The method could not be tested by comparing the resulting parameters with those from other sources, since none were available. This note describes a measurement of Q(v), and presents such a comparison for a system (K–Kr) whose potential parameters have been determined by another method. Author

N64-27555 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
LOW-ENERGY ELECTRON SCATTERING FROM METASTABLE HELIUM
R. H. Neynaber, S. M. Trujillo, Lawrence L. Marino, and Erhard W. Rothe 30 Jun. 1964 14 p refs Submitted for Publication (See N64-27552 19-23)

The total cross section for the scattering of electrons by metastable helium in the 2^3S state was measured at five energies between 0.87 and 8.3 ev by a d.c. atomic beam recoil technique. An electron beam was cross fired at a collimated metastable helium beam. The recoil of atoms caused by electron impact resulted in a decrease in the metastable current observed at a narrow-slit detector. This decrease was measured by an electrometer and was proportional to the desired cross section. The source of metastable atoms was a hot-cathode, low-voltage arc discharge. The beam of 2^3S helium atoms was obtained by state selection using an inhomogeneous magnet, and was detected by measuring the secondary electron current resulting from impacts of the metastable atoms on a gold surface. The experimental results are compared with theoretical estimates. Author

N64-27556 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
INTERACTION POTENTIALS FROM THE VELOCITY DEPENDENCE OF TOTAL ATOM-ATOM SCATTERING CROSS SECTIONS
Erhard W. Rothe, P. K. Rol (Lab. for Mass-Separation, Amsterdam), R. H. Neynaber, and S. M. Trujillo *In its* Mol. Beam Studies of Atomic Collisions 30 Jun. 1964 14 p refs Submitted for Publication (See N64-27552 19-23)

The velocity (v) dependence of the total cross section (Q) was previously measured for the scattering of lithium by all the rare gases and for potassium by krypton and xenon. Assuming a Lennard–Jones (12,6) potential, the depth of the interatomic potential well, ϵ, and the interatomic separation at the zero of potential energy, σ, were obtained from these measurements. From the "experimental" ϵ and σ, a theoretical Q (v) was computed using a partial wave analysis. Good agreement with the experimental data was obtained. In this paper, K-Kr and Li-He, which were studied in the low-velocity region and in the high-velocity region, respectively, are discussed. It is shown that ϵ and σ may be unambiguously determined in the low-velocity region. In the high-velocity region such a determination requires precision that is unattainable with the experimental arrangement used. Author

N64-27557 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
VELOCITY DEPENDENCE OF THE TOTAL CROSS SECTION FOR THE SCATTERING OF METASTABLE $He(^3S_1)$ BY HELIUM, ARGON, AND KRYPTON
Erhard W. Rothe, R. H. Neynaber, and S. M. Trujillo *In its* Mol. Beam Studies of Atomic Collisions 30 Jun. 1964 22 p refs (See N64-27552 19-23)

The velocity (v) dependence of the total cross section (Q) was measured for the scattering of helium in the metastable 2^3S_1 state by ground state helium, argon, and krypton at relative velocities in the range 1,000 to 3,300 m/sec. The results were compared with those previously obtained for the scattering of lithium. For each scattering gas, the shape of Q(v) is similar to that of lithium, but the absolute values for Q are approximately 20% higher. The scattering is largely elastic. It is estimated that the inelastic contribution to Q is about 10% for the He*-He case, and that it is less than 2% for the He*-Ar and He*-Kr cases. The Q(v) for scattering by argon and krypton show undulatory behavior. From the extrema velocities, the product $\epsilon\sigma$ is the same (within $\pm 5\%$) as that for Li scattering, where ϵ is the depth of the interatomic potential well and σ is the interatomic separation at the zero of the potential. A minimum to the number of diatom bound states is established for HeAr ($^3\Sigma^+$) and HeKr ($^3\Sigma^+$). Author

N64-27658 European Organization for Nuclear Research, Geneva (Switzerland)
RANGE MEASUREMENTS FOR MUONS IN THE GeV REGION
A. Buhler, T. Massam, Th. Muller (Centre de Rech. Nucl.), and A. Zichichi 24 Jun. 1964 21 p refs
(CERN-64-31)

The results of an experiment to measure the range of high-energy muons are reported. The reason for carrying out this experiment was the lack of data on muon ranges above a few hundred Mev. This data, were needed for the design of an experiment on proton–antiproton annihilation into muon pairs. On the other hand, the results given in this paper represent the first experimental check of the validity of the range–energy relation for high values of γ, i.e., γ = 12 to 25. Measurements

were made of the muon range in an absorber that consisted mainly of lead, at the momenta P = 1.240 ±0.019 Gev/c, P = 1.790 ±0.027 Gev/c, and P = 2.480 ±0.037 Gev/c. The value of the momentum was determined from the currents in the bending magnets and a calibration of beam momentum as a function of bending-magnet current. Since the range measurements and the calibration were not made simultaneously, a momentum uncertainty equal to the momentum acceptance of the beam is quoted. Author

N64-27676 Weapons Research Establishment (Australia) Dept. of Supply
A PRELIMINARY INVESTIGATION INTO THE OPTICAL PERFORMANCE OF A TWIN ASPHERIC MIRRORED SYSTEM FOR A THERMAL IMAGE CONVERTER
G. Porter May 1964 42 p refs
(WRE-TN-CPD-78)

Presented are details of and results obtained from a limited investigation into one particular optical system that possibly is suitable for use in a thermal image converter. Given are the steps taken and the provisional results and conclusions reached after what eventually came to be only the first stage of the overall optical design project. The system attributed to Schwarzschild, which consists of two aspheric surfaces, is studied, his procedure is expanded, and the suitability of his system for the purpose stated is assessed by ray tracing. Author

N64-27678 Michigan U., Ann Arbor Coll. of Literature, Science, and the Arts
THE RANDOM OPTICS OF PARTICLE BEAMS Technical Report No. 15
Lawrence W. Jones May 1964 16 p
(Contract Nonr-1224(23))
(Rept.-03106-15; AD-441961)

Multiple coulomb scattering, which is generally regarded as an undesirable dirt effect in high energy physics, can be used to focus or deflect beams of energetic particles. For example, a parallel beam of protons passing through a "lens" of lead, made so that the path length in lead increases as the off-axis distance squared, will produce a focal spot of two or more times the intensity of the beam in the absence of the lens. Other configurations of scattering material can produce a net deflection of the beam. By using a high Z material and high-energy beams (>1 Gev) multiple scattering effects become relatively more important than energy loss or nuclear interactions. The application of these ideas to handling beams of muons and electrons is also explored. Corresponding effects such as Compton scattering and nuclear diffraction scattering may be used to "focus" gamma-ray and neutron beams. Author

N64-27681 Optics Technology, Inc., Belmont, Calif.
INFRARED FIBER OPTICS INVESTIGATIONS Final Report, 15 May 1963–15 Apr. 1964
N. S. Kapany and R. J. Simms Wright-Patterson AFB, Ohio, AF Avionics Lab., Jun. 1964 84 p refs
(Contract AF 33(657)-11480)
(AL-TDR-64-98; AD-601572)

The development of the fiber optics technology for a lanthanate–soda lime glass combination and for an arsenic sulphur glass combination is reported. The former glasses can be used over the wavelength range of 0.4μ to 5μ, and the fiber drawing processes are those normally used for high softening point glasses available in a rod and tube form. The fabrication of fused plates, field flatteners, light pipes, image dissectors, and high-resolution imaging cones is reported. The arsenic sulphur glasses, for use over the 1μ to 12μ range are not available in a rod and tube form, so a concentric crucible technique has been developed for the production of single-coated fibers. This process and the processes used for drawing multiple fibers and fabricating components are fully described. These components include high-resolution fused plates, field flatteners, light pipes, image dissectors and low-resolution imaging cones. A full description is also given of the processes developed to evaluate these fiber optics components at infrared wavelengths, and data are presented on the spectral transmission, edge response, and detailed optical transfer functions of each component. Author

N64-27689 Oxford U. (Gt. Brit.) Clarendon Lab.
NUCLEAR RESONANCE IN LIQUID AND SOLID He^3 AT LOW TEMPERATURES Final Technical Status Report, 1 Feb. 1963–31 Jan. 1964
J. Hatton [1964] 28 p refs
(Contract DA-91-591-EUC-2829)
(AD-601582)

The magnetic susceptibility and the spin-lattice relaxation times of liquid and solid He^3 were investigated in the temperature range from about 2.5° K down to 0.07° K and at pressures up to about 200 atm. The apparatus employed and methods of measurement are described. Results are presented in graphical and tabular form. Also, the alpha–beta phase diagram is discussed. I.v.L.

N64-27692 General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
RE-ENTRY PHYSICS RESEARCH Semi-Annual Report, Dec. 1963–May 1964
K. G. P. Sulzmann et al Jun. 1964 71 p refs For Semi-Ann. Rept., May 1963 see N63-20292 20-13
(Contract DA-04-495-ORD-3383(Z), amendment 15; ARPA Order-393, amendment 2; Proj. Defender)
(GDA-DBE64-034; AD-441930)

This report describes the reentry physics research, including the induction period preceding CO_2 formation in shock-heated CO-O_2-Ar mixtures; influence of H_2 on the induction period preceding CO_2 formation in shock heated CO-O_2-Ar mixtures; review of literature on co-oxidation; computer code for chemically reacting, shock-heated mixtures; microwave wake interaction studies; fluid dynamics; hypervelocity wake temperature measurements; 8-mm light-gas-gun range; and 24-in. shock tube. G.D.B.

N64-27719 Wayne State U., Detroit, Mich.
THEORETICAL INVESTIGATIONS ON THE LIGHT SCATTERING SPHERES XVI. RANGE OF PRACTICAL VALIDITY OF THE RAYLEIGH THEORY
Wilfried Heller 14 Jul. 1964 27 p refs Submitted for Publication
(Contract Nonr-3511(00))
(TR-9(55); AD-602902)

The errors committed on using the Rayleigh equations of light scattering at finite α-values were evaluated numerically for spherical nonabsorbing particles using exact Mie data as the reference. The errors considered are Δ_α, Δ'_α, Δ_τ, and Δ_i. Considering an error of 2% as the tolerable maximum, the upper limiting particle diameters that may be evaluated by means of the Rayleigh equations are, expressed in units relative to the wavelength (in the medium) used, 0.124 and 0.207 at

m = 1.00 and 1.30, respectively. These data, which apply to the use of lateral scattering, differ little from the limiting data obtained for diameters derived from turbidity. The errors committed on evaluating turbidity or lateral scattering from the Rayleigh equations are distinctly larger at identical true α-values, and at identical m-values. The interesting fact that the Rayleigh equations perform better than the larger m, as long as $m < \sim 1.8$ opens up the possibility of using these equations for the evaluation of relative large particle diameters provided m is sufficiently large. Thus at $m = 1.63 \pm 0.2$, particle diameters, dimensionally one-third the wavelength in the medium, are obtainable from the Rayleigh equations with 100% theoretical accuracy. This second range of validity of the Rayleigh theory is of major meteorological and astrophysical interest. Author

N64-27720 Wayne State U., Detroit, Mich.
RANGE OF PRACTICAL VALIDITY OF THE DEBYE AND THE RAYLEIGH EQUATIONS FOR DETERMINING MOLECULAR WEIGHTS FROM LIGHT SCATTERING AND METHODS ALLOWING A LIMITED EXTENSION OF THIS RANGE
Wilfried Heller 21 Jul. 1964 28 p refs
(Contract Nonr-3511(00))
(TR-10(56); AD-603083)

Tables and graphs present mathematical proof of the range of practical validity of the Debye and Rayleigh equations. These define completely the range if the particles or molecules are compact and nonswelling. It is also proved that it is not the appearance of dissymmetry but rather the absolute magnitude of dissymmetry that decides the limits for useful practical applications of both equations. A.W.

N64-27760* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
SUPERPOSITION OF SEMI-INFINITE SOLENOIDS FOR CALCULATING MAGNETIC FIELDS OF THICK SOLENOIDS
Gerald V. Brown and Lawrence Flax Repr. from J. Appl. Phys., v. 35, no. 6, Jun. 1964 p 1764–1767 refs
(NASA-RP-287)

Discussed is development of a simplified method for calculating the magnetic field components in or around any thick finite solenoid, based on superposition of the fields of semi-infinite solenoids of zero inner radius. Equations and graphs for the field components of such semi-infinite solenoids are presented. The error involved in the use of these graphs is of the order of a few percent. Greater accuracy, should it be required, is attainable by using tables instead of graphs. IAA

N64-27763 Rochester U., N.Y.
SCATTERING BY SINGULAR LOGARITHMIC POTENTIAL
H. H. Aly, Riazuddin, and A. H. Zimerman 4 Aug. 1964 10 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-50)

Potential of the form $(gr^{-4}\ln^2 r + g^{1/2}r^{-3})\ \theta\ (r-r_0)$ is considered in connection with the applicability of peratization technique. The advantage of this potential is the fact that although it is dominated by a logarithmic part near the origin, the exact solution of the zero energy and s-wave Schrödinger equation is obtained in a closed form. The peratization technique gives the correct answers. Author

N64-27764 Rochester U., N.Y.
SINGULAR LOGARITHMIC POTENTIALS AND PERATIZATION
H. H. Aly, Riazuddin, and A. H. Zimerman 24 Jun. 1964 10 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-42)

Logarithmic singular potentials are considered, to test the applicability of the peratization technique. It is shown that if the leading singular terms in each order of the perturbation series are summed up, no finite results can be obtained. Author

N64-27777 Liege U. (Belgium)
ACCELERATOR TARGETS DESIGNED FOR THE PRODUCTION OF NEUTRONS [BESCHLEUNIGERTARGETS BESTIMMT ZUR HERSTELLUNG VON NEUTRONEN] [CIBLES POUR ACCELERATEURS DESTINEES A LA PRODUCTION DE NEUTRONS]
Brussels, Euratom, May 1964 191 p refs Proceedings of a Meeting, Liege, 17–18 Feb. 1964 In ENGLISH, GERMAN, and FRENCH
(Contract EURATOM-050-63-8)
(EUR-1815.D,F,E) Available from Belg. Am. Bank and Trust Co., N.Y., account no. 22.186: 40 Belg. Fr.

Accelerator targets designed for the production of monoenergetic or polyenergetic neutrons were studied. The discussion relates mainly to tritium targets, with a view to their most efficient use and to the improvements to be made in them in order to increase their life and yield. Author

N64-27787 Weidlinger (Paul), New York, N.Y.
SOUND RADIATION FROM SUBMERGED CYLINDRICAL SHELLS OF FINITE LENGTH
John M. Mc Cormick and Melvin L. Baron Jun. 1964 70 p refs
(Contract Nonr-3454(00) (FBM))
(TR-3; AD-603531)

The development of methods for the evaluation of the pressure field induced in an acoustic fluid by the harmonic excitation of a submerged elastic body is discussed. Specifically, the axisymmetrical loading of a thin elastic circular cylindrical shell of finite length is treated. A general method was developed, using a potential theory-source approach for both the acoustic fluid and the elastic body. G.D.B.

N64-27792 Westinghouse Electric Corp., Pittsburgh, Pa. Physics Dept.
EXPERIMENTS ON RESONANCES IN THE ELASTIC CROSS SECTION OF ELECTRONS ON RARE GAS ATOMS
G. J. Schulz [1964] 32 p refs
(Contract Nonr-2584(00); ARPA Order-125-63; Amendment 10; Proj. Defender)
(TR-24; AD-441157)

Resonances in the elastic scattering are studied in a scattering experiment at an angle of 72° for He and Ne and in a transmission experiment for He, Ne, Kr, and Xe. These resonances result from a compound state of the rare gas atom and occur about 0.5 ev below the first excited state. The magnitude of the resonances can be enhanced in a transmission experiment when only the unscattered electrons are observed. It is pointed out that the resonance in helium can be used for a determination of the apparent electron energy distribution and as a calibration point on the electron energy scale. Author

N64-27798 American Meteorological Society, Boston, Mass.
CONFIGURATION INTERACTION IN THE CARBON ATOM [VZAIMODEISTVIE KONFIGURATSII V ATOME UGLERODA]
A. P. Iutsis Bedford, Mass., AFCRL, Aug. 1963 21 p refs Transl. into ENGLISH from Zh. Eksperim. i Teor. Fiz. (Moscow), v. 19, no. 7, 1949 p 565–576 Previously Published as NASA-TT-F-154; See N63-19861 19-23
(Contract AF 19(604)-6113)
(T-R-404; AD-600890)

The interaction of the $1s^2 2s^2 2p^2$, $1s^2 2p^4$, $1s^2 2s^2 2p 3p$, and $1s^2 2s 2p^2 3s$ configurations of the carbon atom is studied theoretically. The wave functions of the whole atom for these configurations are stated. The matrix elements of energy are expressed through one-electron wave functions. Using one-electron wave functions computed by the method of the self-consistent field without exchange, the matrix elements of energy are computed as diagonal matrix elements and as matrix elements connecting different configurations of the same parity. Secular equations are solved for each type of term of these configurations. Author

N64-27835* National Bureau of Standards, Boulder, Colo. Cryogenic Engineering Lab. Div.
A BIBLIOGRAPHY OF THERMOPHYSICAL PROPERTIES OF ARGON FROM 0 TO 300° K
L. A. Hall, J. G. Hust, and A. L. Gosman 12 Jun. 1964 104 p refs
(NASA Order R-45)
(NASA-CR-56793; NBS-TN-217) GPO: $0.55

A bibliography of 450 references is presented for mechanical, thermodynamic, and transport properties of argon from 0° to 300° K. Each article has been reviewed and coded with regard to properties studied, type of article (i.e., experimental, theoretical, etc.), and method of presentation of the data. The temperature and pressure ranges for each property under consideration are also given. An index was prepared according to property with 4 subcategories: solid, liquid, gas up to 200° K, and gas above 200° K. Author

N64-27855 Admiral Corp., Chicago, Ill. Government Electronics Div.
EFFECTS OF NUCLEAR RADIATION ON FREQUENCY CONTROL DEVICES Sixth Quarterly Report, 1 Dec. 1963–29 Feb. 1964
Bernard Gerstein and Albert Fueyo 31 Mar. 1964 62 p
(Contract DA 36-039 AMC-0000[illegible])
(Rept.-6; AD-603229)

This report deals primarily with preirradiation, in-source, and postirradiation frequency and resistance measurements of CR-19/U crystal units with construction variations. The radiation source used was the Co^{60} facility to a dose of 1×10^7r. Twelve groups with distinctly different construction variations were evaluated. A marked difference was observed in the reaction of the group in which the synthetic quartz was used. Nickel-over-gold electrode plating appears superior. No apparent superiority is evident among bonding materials. Ribbon-type support is inferior to the piano-wire technique. A method of increasing the gamma flux at the pulsed reactor by using polyethylene and cadmium is described. Author

N64-27864 General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
FALLOUT RADIATION ENERGY DISTRIBUTION AS A FUNCTION OF ALTITUDE Final Report
T. W. de Vries 15 Jul. 1964 215 p refs
(Contract OCD-PS-64-31)
(FZK-187; AD-602492)

The gamma-ray spectra in the air above a plane containing fallout fission products have been calculated as a function of time and altitude. Similar calculations were made with the spectra of cobalt-60 and cesium-137 assumed as source terms. An experiment has been designed to measure the spectra calculated for cobalt-60 utilizing 11 cobalt-60 sources and a very sensitive sodium-iodide gamma-ray spectrometer. The results of the calculations indicate that the relative spectra are constant above 800 ft for times after fission greater than 1 day and, furthermore, that the variation of the dose rate with altitude is constant for this time interval. Author

24 PHYSICS, PLASMA

Includes fusion; and magnetohydrodynamics. *For related information see*: 05 Astronomy and Astrophysics; 23 Physics, General; and 25 Physics, Solid-State.

N64-26998 Physics, Engineering, Chemistry Corp., Boulder, Colo.
INVESTIGATION OF THE DYNAMICS OF IONIZED MEDIA (PLASMAS)
Wesley E. Britten, Willard R. Chappell, Arthur Y. Sakakura, and Robert G. Kuller Wright-Patterson AFB, Ohio, ARL May 1964 193 p refs
(Contract AF(657)-8131)
(ARL-64-85; AD-603336)

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5. KINETIC EQUATIONS FOR THE ELECTRON PHOTON GAS p 139–161 refs
6. MATHEMATICAL APPENDIX p 162–185 refs (See N64-27000 19-23)

N64-26999 Physics, Engineering, Chemistry Corp., Boulder, Colo.
THE STATISTICAL MECHANICS OF A SIMPLE STRING
In its Investigation of the Dynamics of Ionized Media (Plasmas) May 1964 p 1–15 (See N64-26998 19-24)

The statistical mechanics of the electromagnetic field is treated in a fundamental way. Probability densities for the fields $\vec{E}$ and $\vec{B}$ at given points are the basic entities entering the theory. These densities satisfy an infinite set of coupled equations (hierarchy) analogous to but quite different in structure from the usual BBKGY hierarchy for particles. When particles are included, the equations for joint field-particle probabilities are also given. Some examples of methods useful in treating equilibrium and transport phenomena in both classical and quantum plasmas are discussed. Author

N64-27002 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
RADIO ENGINEERING AND ELECTRONICS Selected Articles
26 May 1964 29 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 8, no. 7, 1963 p 1179–1186, 1269–1274
(FTD-TT-64-292/1+2+4; AD-601761)

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2. PROPAGATION OF ELECTROMAGNETIC ENERGY IN A CIRCULAR WAVE GUIDE FILLED BY A GAS-DISCHARGE PLASMA WITH VARIABLE PARAMETERS WITH RESPECT TO THE CROSS SECTION V. M. Ginzburg p 16–26 refs (See N64-27004 19-24)

N64-27003 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ABOUT ONE MECHANISM OF GENERATING PLASMA OSCILLATIONS IN A SEMICONDUCTOR
V. L. Bonch-Bruyevich and Yu. V. Gulyayev *In its* Radio Eng. and Electron. 26 May 1964 p 1–15 refs (See N64-27002 19-24)

This is a problem about the generation of plasma waves by electron flow in a semiconductor. The presence of several branches of a plasma spectrum in a bipolar plasma is taken into consideration. An evaluation of the critical drift velocity at which generation can begin is given, and the possible paths of creating such a velocity are pointed out. Author

N64-27004 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
PROPAGATION OF ELECTROMAGNETIC ENERGY IN A CIRCULAR WAVE GUIDE FILLED BY A GAS-DISCHARGE PLASMA WITH VARIABLE PARAMETERS WITH RESPECT TO THE CROSS SECTION
V. M. Ginzburg *In its* Radio Eng. and Electron. 26 May 1964 p 16–26 refs (See N64-27002 19-24)

The results of theoretical and experimental investigations of the propagation of electromagnetic waves through a waveguide containing a plasma are presented. Formulas are given for determining the mean concentration of electrons with respect to the deflection of beams from a slot-antenna filled with a plasma. R.T.K.

N64-27143 Princeton U., N.J. Plasma Physics Lab.
SOME CONSTANTS OF THE LINEARIZED MOTION OF VLASOV PLASMAS
C. Oberman and M. Kruskal Apr. 1964 34 p refs
(Contract AT(30-1)-1238)
(MATT-253)

A new class of nonlocal constants for the linearized Vlasov equations is presented. These are constants, which, in general, are not expressible as simple phase space integrals of a locally defined integrand. The relevance of these constants to stability considerations is indicated. Author

N64-27155 Joint Publications Research Service, Washington, D.C.
COMPLEX DIELECTRIC CONSTANT OF A MAGNETOACTIVE PLASMA AT LOW FREQUENCIES
S. B. Biragov *In its* Izv. VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 86–97 refs (See N64-27151 19-08) OTS: $4.00

The kinetic equations for the distribution functions of the electrons and ions are solved in the linear approximation. The distribution functions are represented in the form of expansions in Sonine polynomials. An estimate is made of the influence of ion-ion collisions on the complex dielectric constant of the plasma. It is shown that the ion-ion collisions are insignificant in a fully ionized plasma (at $T_e = T_i$ and $N_e = N_i$), and also in a weakly ionized plasma for a definite law of interaction with the molecules. Author

N64-27156 Joint Publications Research Service, Washington, D.C.
GYRORESONANT RADIATION AND ABSORPTION IN AN EQUILIBRIUM MAGNETOACTIVE PLASMA
V. V. Zheleznyakov *In its* Izv. VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 98–121 refs (See N64-27151 19-08) OTS: $4.00

The radiation of a weakly relativistic electron moving along a helical line in a magnetoactive plasma is considered. Kirchhoff's law is used to obtain the coefficient absorption of electromagnetic waves in an equilibrium plasma at frequencies $\omega \sim s\omega_H (s = 1, 2, 3, \ldots; \omega_H$—electron gyrofrequency); this absorption is connected with cyclotron radiation of weakly relativistic electrons contained in the plasma. The expressions obtained are compared with the corresponding absorption coefficients obtained by the method of kinetic equations with self-consistent fields. Author

N64-27157 Joint Publications Research Service, Washington, D.C.
PASSAGE OF ION BEAMS THROUGH A PLASMA
V. B. Krasovitskiy and K. N. Stepanov *In its* Izv. VUZov: Radiophys., No. 1, 1964 19 Jun. 1964 p 122–137 refs (See N64-27151 19-08) OTS: $4.00

The excitation of electromagnetic waves in a plasma by a beam of ions with low density and large thermal velocity scatter is investigated in the frequency region $\omega_H >> \omega >> \omega_i$ (ω_H—gyrofrequency of the electron; ω_i—gyrofrequency of the ions). It is assumed that the ion beam is injected into the plasma at a large angle to the external magnetic field H_0, so that $v_{0\parallel} \approx v_{0\perp} >> v_T$ ($v_{0\parallel}$ and $v_{0\perp}$ are the components of H_0 that are parallel and perpendicular to the velocity of the beam, and v_T is the average thermal velocity of the beam particles). It is shown that the growth increment increases appreciably compared with the case of a beam parallel to H_0. Author

N64-27158 Joint Publications Research Service, Washington, D.C.
ON THE THEORY OF INTERACTION OF WAVES IN A PLASMA
I. A. Daneliya and N. L. Tsintsadze *In its* Izv. VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 138–146 refs (See N64-27151 19-08) OTS :$4.00

The occurrence of nonlinear electromagnetic and longitudinal waves due to the interaction of longitudinal oscillations is considered. The radiation of the electromagnetic field occurs in a cold plasma only if the direction of propagation of the waves does not coincide with the anisotropy axis, the role of which is assumed by the direction of motion of the particle beam. Expressions are obtained for the mean value of the flux of transported matter. Author

N64-27160 Joint Publications Research Service, Washington, D.C.
FLUCTUATIONS IN PERIODICALLY NONSTATIONARY SYSTEMS
V. N. Lugovoy *In its* Izv. VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 165–180 refs (See N64-27151 19-08) OTS: $4.00

A generalization of the fluctuation-dissipation theorem to the case of classical periodically nonstationary "equilibrium" systems is presented. A connection is established between the spectral characteristics of discrete fluctuating quantities and the impedance matrix of the system. The corresponding results extend to distributed systems and are applied to electromagnetic fluctuations in periodically nonstationary equilibrium media. By way of a specific example, electromagnetic fluctuations are considered, due to a rarefied electron plasma situated in a strong external periodic magnetic field and contained within a cavity resonator with perfectly conducting walls. Author

N64-27161 Joint Publications Research Service, Washington, D.C.
TWO-DIMENSIONAL ELECTROMAGNETIC FIELDS GUIDED BY PLASMA LAYERS. I
I. G. Kondrat'yev and M. A. Miller *In its* Izv. VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 181–197 refs (See N64-27151 19-08) OTS: $4.00

Two-dimensional electromagnetic waves are considered, guided by piecewise homogeneous isotropic plasma layers. In three cases, the reflection coefficient of the electromagnetic wave from a single plasma layer is close to unity: (1) when the electron concentration inside the layer is sufficiently large; (2) for glancing rays and arbitrary concentration; (3) for TM wave incident on the so-called zero layer $\epsilon = 0$. Related to them is also the case of complex angles of incidence, corresponding to surface waves. All these possibilities can be utilized to construct waveguide systems with plasma walls. The characteristics of such systems are considered, namely the radiation losses, the role of collisions and spatial dispersion, and an estimate of the influence of focusing magnetic fields. Author

N64-27167 Joint Publications Research Center, Washington, D.C.
FIELD STRUCTURE INSIDE A PLASMA LAYER WITH ZERO PERMITTIVITY
I. G. Kondrat'yev and M. A. Miller *In its* Izv. VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 260–265 refs (See N64-27151 19-08) OTS: $4.00

Allowance for the spatial dispersion does not eliminate the effect of total screening and leads only to a shift of the resonant value of E away from zero. The zero layer becomes slightly transparent for TM waves; the penetration of energy through the layer occurs naturally, as a result of the finite value of the Poynting vector and, consequently, the nonvanishing of not only the electric field but also the magnetic field inside the layer. G.D.B.

N64-27168 Joint Publications Research Service, Washington, D.C.
RADIATION OF LONGITUDINAL WAVES IN MEDIA WITH WEAK SPATIAL DISPERSIONS
M. L. Levin *In its* Izv. VUZov: Radiophys., no. 1, 1964 19 Jun. 1964 p 266–268 refs (See N64-27151 19-08) OTS: $4.00

This brief paper shows that when the longitudinal field of sources situated in the dispersive medium itself is considered, the second expansion is more correct. For simplicity, the problem is confined to the isotropic case, and the dispersion of the transverse waves is neglected. G.D.B.

N64-27248* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE STRUCTURE OF A COLLISION FREE WAVE IN A PLASMA TRANSVERSE TO A MAGNETIC FIELD
R. K. Jaggi and A. P. Stokes Feb. 1964 26 p refs
(NASA-TM-X-55010; X-640-64-34) OTS: $2.60 ph

In this paper the problem of the structure of a strong collision free wave in a plasma perpendicular to its magnetic field is considered. Conditions on the two sides of the wave are the same and are separated by a solitary pulse provided the kinetic energy of the motion at one end of the wave ($x = -\infty$, say) is less than the sum of magnetic and thermal energy of the plasma. If the kinetic energy is more than the sum of magnetic and thermal energy, no wave exists and the constant solution at $x = -\infty$ is the only solution of the equations describing the waveform. Author

N64-27290* Texas A&M U., College Station
THE SCATTERING OF PULSED LASER LIGHT FROM PLASMAS
Melvin Eisner [1964] 13 p
(Grant NsG-239-62; Proj. No. 4)
(NASA-CR-56889) OTS: $1.60 ph

The availability of intense monochromatic sources provided by pulsed lasers makes it possible to attempt observation of both the angular distribution and spectral distribution of laser light scattered from plasmas of relatively modest densities and temperatures. Scattering theory is discussed. The design of an experiment to study free particle-scattering modes is presented, and a steady-state experiment being conducted in an attempt to observe the electron velocity distribution in a plasma produced by an RF discharge is discussed. R.T.K.

N64-27300* Avco Everett Research Lab., Everett, Mass.
[HEAT TRANSFER, RADIATION IN N_2-CO_2 MIXTURES, AND SHOCK FRONT SPECTROSCOPY AND MAGNETOHYDRODYNAMIC SUPPORT] Final Report
Jul. 1964 18 p refs
(Contract NASw-748)
(NASA-CR-58050) OTS: $1.60 ph

This report discusses heat-transfer measurements, convective heat transfer, radiation in nitrogen-CO_2 mixtures, shock-front studies, and magnetohydrodynamics. A.W.

N64-27359* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PHOTONS IN MAGNETIC FIELDS
G. K. Oertel Repr. from Nature (London), v. 202, no. 4933, 16 May 1964 p 684–685 refs
(NASA-RP-285)

The absorption coefficient of a magnetic field for photons of sufficient energy to produce electron-positron pairs is discussed. A mathematical investigation of the propagation

laws of characteristic singularities of the equations of gravitation indicated that certain of such singularities of the gravitational field equations combined with Maxwell's equations exhibit properties consistent with their interpretation as photons. These singularities show a peculiar behavior under the influence of electric and magnetic fields. A coupling between the two can take place under the influence of electric and magnetic fields that are perpendicular to the direction of motion. P.V.E.

N64-27460 Princeton U., N.J. Plasma Physics Lab.
A NOTE ON SATURATION ION CURRENTS TO LANGMUIR PROBES
Francis F. Chen Jun. 19 p refs
(Contract AT(30-1)-1238)
(MATT-272)

The parabolic variation of saturation ion current with probe potential observed in dense plasmas is fortuitous and is unrelated to the effects of orbital motion. Agreement between measured and computed saturation ion characteristics is illustrated. The discussion is in the framework of collisionless, magnetic-field-free theories; they apply to the experiments only if the ion Larmor radius is much larger than the probe radius. Author

N64-27465 Maryland U., College Park
A CRITICAL SURVEY OF MAGNETOFLUID DYNAMICS. PART II: MAGNETOHYDRODYNAMIC CHANNEL FLOWS
Shih I. Pai Wright-Patterson AFB, Ohio, ARL, May 1964 55 p refs
(Contract AF 33(657)-7805)
(ARL-63-175, Part II; AD-603386) OTS: $3.00

This report gives a critical survey of the flow of an electrically conducting liquid in a pipe or channel under the influence of a transverse electromagnetic field. The fundamental principles on which the analysis of the magnetohydrodynamic-channel flow is based are discussed. Various MHD channel flows, which contain the generalized Hartmann flow, laminar flow in pipes, unsteady flow, and turbulent flow, are analyzed in detail. The present knowledge of MHD channel flow is summarized. Author

N64-27468 Cincinnati U., Ohio
SIMILARITY RULES OF THE FLOW OF A PERFECTLY CONDUCTING GAS WITH AN ALIGNED MAGNETIC FIELD
Kinzo Hida Wright-Patterson AFB, Ohio, ARL, Jul. 1964 54 p refs
(Contract AF 33(616)-8453)
(ARL-64-113; AD-603621) OTS: $1.50

Two-dimensional steady flows of an inviscid, compressible, perfectly conducting gas with an aligned magnetic field are classified into several regimes, depending on the values of the Mach number, M, and the Alfvénic Mach number, A. Similarity rules for the flow past a slender body are obtained for the purely elliptic or hyperbolic flow and the various transitional regimes such as transonic ($M \doteq 1$), trans-Alfvénic ($A \doteq 1$), and hypercritical flows ($M^2 + A^2 \doteq 1$). Special references are made to the shock relation, and critical shock polars are found in each transition region. Flows near the point of intersection of any two of these transition lines are characterized by a pair of similarity parameters in each case. Author

N64-27498 Chalmers U. of Tech., Goteborg (Sweden) Research Lab. of Electronics
DYNAMIC NON-LINEAR WAVE PROPAGATION IN IONIZED MEDIA. 13: MICROSCOPIC TREATMENT OF THE INTERACTION BETWEEN A PLANE ELECTROMAGNETIC WAVE AND AN OSCILLATING MEDIUM Research Report No. 44
A. R. Thomasson Mar. 1964 57 p refs
(Contract AF 61(052)-451)
(AFCRL-64-532; US-38; AD-602986)

The interaction between an electromagnetic wave and an oscillating dielectric medium is studied from a microscopic point of view. Modifications of the Lorentz–Lorenz formula and the Oseen extinction theorem are discussed. The diffraction conditions at a plane boundary are considered, and the effect of a drifting disturbance is taken into account. Author

N64-27499 Chalmers U. of Tech., Goteborg (Sweden) Research Lab. of Electronics
DYNAMIC NON-LINEAR WAVE PROPAGATION IN IONIZED MEDIA. 14: GENERATION OF LONGITUDINAL PLASMA WAVES BY NON-LINEAR COUPLING OF TWO HIGH-POWER CIRCULARLY POLARIZED TRANSVERSE WAVES Research Report No. 45
K. H. B. Wilhelmsson 1 Apr. 1964 22 p refs
(Contract AF 61(052)-451)
(AFCRL-64-533; US-39; AD-602987)

The investigation shows that nonlinear interaction between two transverse waves, propagating along a magnetic field in an electron stream that interpenetrates an ionized gas, can cause a difference-frequency longitudinal space charge wave. Under certain conditions on the primary waves the degree of coupling may become appreciable. Author

N64-27542 Sylvania Electric Products, Inc., Waltham, Mass. Sylvania Electronic Systems
A STUDY OF EXTREMELY-LOW-FREQUENCY WAVE MOTIONS Final Report
A. Cantor and V. Farber 26 Feb. 1964 111 p refs
(Contract AF 19(628)-340)
(F-2023-1; AFCRL-64-280; AD-601608) OTS: $2.50

The behavior of a model ionospheric plasma is studied in the extra-low-frequency limit, and from several points of view. The normal and anomalous Cerenkov-like effects there derived are considered further, and improvements in the theoretical formulation of plasma problems are considered. The effect of a spiralling of the charges in the source exciting the Cerenkov-like effects was estimated, and the likelihood of detecting these effects in the ionosphere or in the laboratory was considered. How the electromagnetic-excitation formulation used in this work is to be applied to the calculation of the stopping power of a plasma is shown, and a need to improve the description of the interparticle forces is seen. A parallel magnetohydrodynamic formalism was set up for problems involving pressure disturbances, and finite as well as infinite conductivities, plus a simple pressure excitation problem, is discussed. Author

N64-27547 Electro-Optical Systems, Inc., Pasadena, Calif.
RESEARCH ON CESIUM VAPOR Final Report, 1 May-30 Sep. 1963
A. O. Jensen 30 Oct. 1963 50 p refs
(Contract Nonr-3805(00))
(EOS-3130, Final; AD-422661)

The results of absolute absorption measurements near the resonance levels in cesium vapor show that, for cesium pressure ranges of interest to high power density cesium vapor

thermionic converters, the atomic resonance absorption at 8.521 and 8.943 A is considerably greater than previously indicated in the literature. In addition to the resonance absorption, molecular absorption bands in the vicinity of 7,600 A were found and are strong enough to furnish an additional significant source of energy input to the plasma of a cesium vapor thermionic converter. On the basis of this absorption spectra, an ionization mechanism has been hypothesized for the production of the dominant ionic specie for space charge neutralization in high pressure cesium vapor thermionic converter plasmas. The mechanism consists of cesium atoms first being excited to approximately the 1.45-ev level by resonance radiation from the emitter and subsequently colliding with other excited atoms to form the molecular cesium ion: $Cs^* + Cs^* + (\text{heat of formation of } Cs_2) \rightarrow Cs_2^+ + \bar{e}$. Author

N64-27562 United Aircraft Corp., East Hartford, Conn. Research Labs.
RESEARCH ON THE ELECTRICAL BREAKDOWN OF GASES UNDER INTENSE OPTICAL ILLUMINATION Final Report, Aug. 1, 1963–Jan. 30, 1964
R. G. Meyerand, Jr., and A. F. Haught 27 Jan. 1964 23 p refs
(Contract Nonr-4299(00); ARPA Order 306; Proj. Defender)
(C-920088-2; AD-428206)

A theoretical and experimental research program was conducted on the physical mechanisms associated with the electrical breakdown of gases under the intense optical illumination from a laser. The light beam from a ruby laser was focused to a small region in the center of a test cell to ionize helium, argon, and air. Breakdown in air required the highest field strengths, the next highest were required to ionize helium, and the lowest field strengths were required for argon. Theoretical studies indicated that the inverse bremsstrahlung process, involving the absorption of optical photons by free electrons during collisions with gas atoms, satisfactorily accounts for the high degree of ionization produced during the short laser pulse and, in addition, predicts the observed pressure dependence of the breakdown. It was observed that as much as 50% of the total energy in the laser beam was absorbed in the plasma produced by breakdown and attenuations by as much as a factor of 10 were observed in the intensity of the laser beam at later times in the optical pulse. An extension of inverse bremsstrahlung to the fully ionized case shows considerable promise as the process to account for this absorption. Author

N64-27690 Temple U., Philadelphia, Pa.
RESEARCH ON PLASMA ACCELERATION Final Report
T. Korneff 10 Feb. 1964 28 p refs
(Contract DA-36-034-ORD-3599 RD)
(AD-441171)

Several methods for the measurement of the arrival of the explosion products of conical gun explosions and exploding wires in rail gun symmetries have been examined. The methods examined were the biased gap, "plasma-eater," and capacitor microphone. The capacitor-microphone system, when incorporated into an FM transmitter, gives promise of producing a relatively noise-free system for these measurements. Significant responses due to impinging material have been obtained, using the capacitor microphone. The "plasma-eater" shows definite signs of measuring quantitatively the density of the on-coming material. However, shielding problems due to electromagnetic interference are great. Author

N64-27736 Massachusetts Inst. of Tech., Cambridge Research Lab. of Electronics
RESEARCH ON NEW CONCEPTS IN ENERGY CONVERSION Quarterly Technical Progress Report, 1 Mar.–31 May 1964
W. D. Jackson, G. A. Brown, J. L. Kerrebrock, and E. N. Carabateas 15 Jun. 1964 24 p refs Suppl. to QPR No. 74
(Contract AF 33(615)-1083)
(QTPR-3; AD-603235)

Report is made of progress in research on the following new concepts of energy conversion: (1) magnetohydrodynamic power generation with liquid metals; (2) liquid–metal magnetohydrodynamic generators; (3) alkali–metal magnetohydrodynamic generators; and (4) thermionic energy conversion. The experiments confirmed that small (approximately nucleation-sized) drops should depress the electron temperature, and the conductivity, in nonequilibrium plasmas. Theoretically, it was concluded that the influence of droplets on the equilibrium conductivity of a wet alkali–metal vapor is not important for MHD generators, and large drops (greater than 100-Angstrom radius) should have little effect on the conductivity. A.W.

25 PHYSICS, SOLID-STATE

Includes semiconductor theory; and masers. *For related information see*: 09 Electronics; 23 Physics, General; and 24 Physics, Plasma.

N64-27061 Joint Publications Research Service, Washington, D.C.
ELEVENTH CONFERENCE ON THE PHYSICAL BASES OF CATHODE ELECTRONICS
10 Aug. 1964 33 p Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), no. 6, 1964 p 1099–1113
(JPRS-25811; TT-64-41082) OTS: $2.00

The content of each report presented at the conference is briefly summarized. The proceedings of the conference were divided into the following sections: (1) "The Structure and Electronic Properties of Solid Bodies and Their Surfaces"; (2) "Thermoelectronic Emission"; (3) "Effective Thermocathodes"; (4) "Thermoelectronic Transformation of Energy"; (5) "Secondary Electronic Emission"; (6) "Photoelectric Emission"; (7) "Autoelectronic Emission"; and (8) "The Surface Reaction of a Solid with Heavy Particles." D.S.G.

N64-27080 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
ANISOTROPIC COEFFICIENT OF ION-ELECTRON EMISSION IN SINGLE CRYSTALS
Ye. S. Mashkova, V. A. Molchanov, and D. D. Odintsov 23 Mar. 1964 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 151, no. 5, 1963 p 1074–1075
(FTD-TT-64-130/1+2+4; AD-435987)

The coefficient of ion–electron emission is defined as the ratio of secondary flux to ion flux in ionic irradiation of metallic surfaces. The dependence of the coefficient of ion–electron emission from the face (100) of a single crystal of copper on the incident angle of ions onto the target was measured, using singly charged argon ions of energy 20 and 30 Kev. The coefficient proved to be clearly anisotropic; when the direction of the beam of primary ions coincided with the basic crystallographic axes of the target, a sharp reduction in the number of emitted electrons was observed. D.S.G.

N64-27100 Case Inst. of Tech., Cleveland, Ohio
A STUDY OF PERIODIC MEDIA WITH NON-ORTHOGONAL LATTICE STRUCTURE Scientific Report No. 6
Haim Haskal May 1964 157 p refs
(Contract AF 19(628)-1699)
(AFCRL-64-437; AD-603035)

A theory is developed for electromagnetic wave propagation in three-dimensional periodic media with nonorthogonal lattice structure. The generalized transmission line approach is used. The equivalent circuit matrices describing each plane of obstacles are examined in detail. Detailed results for a non-orthogonal lattice of small circular disks are obtained. In addition, disk and strip media with adjacent planes of obstacles obtained by a combination of rotation and translation are examined. Some unusual features of the band structure for such media are described. Author

N64-27174 Chicago U., Ill. Inst. for the Study of Metals
RESISTIVITY AND HALL EFFECT IN LIQUID METALS
Bernard Springer (Ph.D. Thesis) [1963] 46 p refs
(AD-439050)

A liquid metal in which the unscreened electron-ion interaction is the sum of spherically symmetric potentials is assumed. Using an exact expression for the conductivity tensor in a magnetic field, expressions are obtained for the Hall constant R and for the zero-magnetic-field frequency-dependent conductivity tensor $\sigma^{0}_{\mu\mu}(\omega)$ in the form of power series expansions in the potential. Effects due to the electron spin are ignored. Calculations are done for Zn, Li, and Na using the pseudopotentials calculated by Harrision. For Zn it is shown that the series for $\sigma^{0}_{\mu\mu}(\omega)$ converges slowly if it converges at all. It is concluded that the small pseudopotential approximation is not convenient for, and possibly not valid for, dealing with electrical transport in liquid metals. Author

N64-27176 Joint Publications Research Service, Washington, D.C.
STUDIES IN SOVIET METALLURGY
30 Jun. 1964 22 p refs Transl. into ENGLISH of 2 articles from Met., Metalloved., Fizikokhim. Metody Issled., Tr. Inst. Met. Akad. Nauk SSSR (Moscow), no. 6, 1960 p 41–53 (JPRS-25289; TT-64-31580) OTS: $0.75

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1. CERTAIN FEATURES OF THE ELECTRON SPECTRUM OF SUPERCONDUCTORS I. B. Borovskiy p 1–13 refs (See N64-27177 19-25)
2. X-RAY SPECTRA OF THE SUPERCONDUCTING COMPOUND CuS I. B. Borovskiy and I. A. Ovsyannikov p 14–20 refs (See N64-27178 19-25)

N64-27177 Joint Publications Research Service, Washington, D.C.
CERTAIN FEATURES OF THE ELECTRON SPECTRUM OF SUPERCONDUCTORS
I. B. Borovskiy *In its* Studies in Soviet Met. 30 Jun. 1964 p 1–13 refs (See N64-27176 19-25) OTS: $0.75

Metals and compounds exhibiting superconductivity were investigated. Conclusions drawn from the literature concern the electron energy spectrum and electron density, the excitation spectrum near the Fermi surface, and positions of superconducting metals in the periodic table. The X-ray spectra, both absorption and emission, were studied for $CoSi_2$ and CuS, and the predicted differences from the spectra of Co and Cu were confirmed. D.E.W.

N64-27178 Joint Publications Research Service, Washington, D.C.
X-RAY SPECTRA OF THE SUPERCONDUCTING COMPOUND CuS
I. B. Borovskiy and I. A. Ovsyannikov *In its* Studies in Soviet Met. 30 Jun. 1964 p 14–20 refs (See N64-27176 19-25) OTS: $0.75

The substructure of X-ray K-absorption and emission spectra of sulfur and copper in pure elements and in CuS was studied. Observations and conclusions are stated with regard to a break in the pure-sulfur spectrum, ΔE for sulfur in CuS, intensity relationships between various lines of sulfur, sulfur doublet displacement in other binary compounds but not in CuS, and K-absorption margins. Electron structures of gaseous and solid sulfur and of copper are inferred. D.E.W.

N64-27188 France. Ministere de l'Air, Paris
STUDY OF THE VALENCE BAND OF GERMANIUM BY CYCLOTRON RESONANCE [ETUDE DE LA BANDE DE VALENCE DU GERMANIUM PAR RESONANCE CYCLOTRON]
Wladimir Mercouroff Serv. de Doc. Sci. et Tech de l'Armement Jan. 1964 87 p refs In FRENCH *Its* Publ. Sci. et Tech. no. NT-133

The effect of valence band degeneration of germanium at the center of the first Brillouin zone on cyclotron resonance with smooth holes was studied. From the classical point of view, deformation of surfaces with constant energy can produce, under certain crystallographic orientations, several resonant rays. Within quantum limits, when thermal excitation energy is weak before energy of cyclotron resonance, a fine structure of cyclotron resonance may be observed due to transitions between the first two Landau levels. The cumulative effects allow the precision of germanium band valence parameters. G.D.B.

N64-27216 Chicago U., Ill. Inst. for the Study of Metals
DIFFRACTION STUDIES OF CRYSTAL IMPERFECTIONS Final Report, Jul. 1, 1961–Jun. 30, 1964
C. S. Barrett 30 Jun. 1964 7 p
(Grant DA-ARO(D)-31-124-G152)
(AROD-2178-8; AD-443952)

Results obtained are summarized in the following areas: (1) a neutron diffraction study of short-range order in β-CuZn; (2) a reanalysis of short-range order in Cu_3Au; (3) a single crystal X-ray study of order in β'-AgCd; (4) a diffraction theory for alloys with temperature and atomic size effects; (5) short-range order in α-CuZn; (6) a new low-temperature X-ray diffraction apparatus; (7) investigation of crystals with van der Waals binding; (8) lattice constants and thermal expansion characteristics of face-centered cubic argon; and (9) the crystal structures of antiferromagnetic fluorides resulting from antiferromagnetic transition. R.T.K.

N64-27235 Servomechanisms Inc., Goleta, Calif. Research and Development Center
THIN FILM RESEARCH
Edward J. Soxman and Gordon N. Steele 4 Nov. 1963 68 p refs
(Contract Nonr-4165(00))
(SMIR-63-3; AD-437866)

Small crossed-grid arrays of electroluminescent cells having a resolution of 33 lines per inch were made by vacuum deposition of the phosphor, ZnS:Mn. A thick, low-conductivity

layer of GeO_2 was included in most of the devices. Current-voltage measurements were made for films with thicknesses between a few hundred and fifty thousand Angstroms. Direct current electroluminescence at high applied voltages was observed in both polarities of voltage. Tunneling through thin organic films was investigated with fluorescein that had been deposited, either with or without a prepolarizing field. D.E.W.

N64-27344 Purdue U., Lafayette, Ind.
SEMICONDUCTOR RESEARCH Semiannual Report, 1 Oct. 1963–31 Mar. 1964
[1964] 41 p refs
(Contract DA-31-124-ARO(D)-17)
(AD-439233)

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13. STUDY OF THE PROPAGATION OF TRANSVERSE ACOUSTIC WAVES IN METALS IN A LONGITUDINAL MAGNETIC FIELD J. J. Quinn and S. Rodriguez p 20
14. IONIZED IMPURITY SCATTERING IN DEGENERATE MANY-VALLEY SEMICONDUCTORS J. E. Robinson and S. Rodriguez p 20–21

N64-27423 Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
FERRIMAGNETIC RESONANCE RELATIONS FOR MAGNETOCRYSTALLINE ANISOTROPY IN CUBIC CRYSTALS Special Report No. 2
Hans Roland Zapp Apr. 1964 110 p refs
(AFCRL-64-72; AD-603593)

A general resonance equation that directly relates the resonance frequency to the static applied field and internal anisotropy field for cubic ferrimagnets has been derived. The equation is valid for an infinite number of planes that contain the 110 direction. The limitations and difficulties of other approaches outlined in the literature are mentioned. The advantages and disadvantages of the derivation contained in this thesis are explained. Certain interesting features of the resonance relationship are mentioned. The theoretical calculations give very close agreement to the experimental observations on yttrium iron garnet (YIG), as well as gallium- and indium-substituted YIG's. The theoretical calculations, however, increasingly deviate from experimental results as the internal anisotropy fields increase. Author

N64-27425 Dayton U., Ohio Research Inst.
OPTICAL PROPERTIES OF SEMICONDUCTING CRYSTALS
Werner R. Rambauske Wright-Patterson AFB, Ohio, ARL, Jun. 1964 50 p refs
(Contract AF 33(616)-7500)
(ARL-64-98) OTS: $1.25

An extended program about optical properties of some selected semiconducting crystals under varied conditions of temperature, pressure, magnetic and electric fields, means of excitation, and influence of impurities is briefly summarized. Author

N64-27448 Harvard U., Cambridge, Mass. Div. of Engineering and Applied Physics
INTRABAND AND INTERBAND SCATTERING IN N-TYPE GERMANIUM
Shan-Chun Yu 10 Jan. 1964 83 p refs
(Contract ARPA-SD-88)
(ARPA-TR-10; AD-441833)

The theory of Nathan, Paul, and Brooks for the interband scattering in n-type germanium is extended to cover the effects of phonon energy and anisotropic scattering. Intraband and interband scattering times are derived from the Boltzmann equation using Herring and Vogt's spherical harmonic approximation for the electron distribution function. The matrix element for the intraband acoustic mode scattering is expressed in terms of two deformation potential constants, E_1 and E_2, as defined by Brooks. In deriving the interband scattering time, it is assumed that an upper band state and a lower band state between which interband scattering can occur are well separated in k-space so that the interband scattering matrix element may be treated as independent of both the initial and the final states. To simplify the calculations, electrons are first assumed to be scattered from one band to another only by longitudinal acoustic phonons, and the effect of pressure on the anisotropy is neglected. By fitting the theory to experimental conductivity data, the energy separation between the two conduction band edges was found to be (0.17 ± 0.03) ev. Author

N64-27473 Air Force Cambridge Research Labs., Bedford, Mass.
A STUDY OF TRANSVERSE MODES OF RUBY LASERS USING BEAT FREQUENCY DETECTION AND FAST PHOTOGRAPHY
C. Martin Stickley (Ph.D. Thesis–Northwestern U.) May 1964 88 p refs *Its* Phys. Sci. Res. Papers No. 19
(AFCRL-64-434; AD-603594)

Intensity variations in the frequency range of 6 to 141 mcps have been detected in the output of ruby lasers. These

are interpreted to be beats between simultaneously occurring transverse modes with the same axial mode number, rather than beats between two modes in regions of the ruby rod having slightly different path lengths. Evidence for this interpretation was provided primarily by two experiments: (1) The beats disappeared when the ruby laser rod was operated with small mirrors. (2) Streak photographs of a narrow strip of the end of the rod always showed a phase variation across the rod of the beat frequency. A review of laser resonator theory is given. Extensive measurements of a ruby rod whose path length variations were approximatly $\lambda/10$ showed that the transverse modes and beat frequencies were characteristic of a nonconfocal resonator rather than a plane-parallel resonator. Author

N64-27523 Naval Research Lab., Washington, D.C. Solid State Div.
ENERGY TRANSFER IN DOUBLY ACTIVATED BARIUM CROWN GLASS
H. W. Gandy, R. J. Ginther, and J. F. Weller May 1964 9 p refs
(Contract ARPA Order 306-62)
(NRL-1525; AD-441832)

The transfer of energy absorbed by uranyl ion (UO_2^{++}) to neodymium ion causing Nd^{3+} luminescence has been observed in a barium crown glass host matrix. Resonance (radiationless) transfer of energy is the dominant mechanism active in this material. A discussion of the results and possible applications is presented. Author

N64-27550 Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center
FORSTERITE, DATA SHEETS
John T. Milek Aug. 1963 33 p refs
(Contract AF 33(615)-1235)
(DS-129; AD-421883)

This report contains data sheets on Forsterite. Included are data on dielectric constant, dielectric strength, dissipation factors, electrical resistivity, loss factor, power factor, and Te value. G.D.B.

N64-27551 Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center
GERMANIUM, DATA SHEETS
M. Neuberger Sep. 1963 63 p refs
(Contract AF 33(615)-1235)
(DS-131; AD-421912)

Germanium data sheets are presented for absorption, dielectric constant, effective mass, energy bands, energy gap, and energy levels. G.D.B.

N64-27558 Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center
ZINC SELENIDE Data Sheets
M. Neuberger Sep. 1963 31 p refs
(Contract AF 33(616)-8438)
(DS-132; AD-421964)

This report contains data sheets on zinc selenide. Included are data on absorption, Debye temperature, dielectric constant, effective mass, electrical conductivity, electrical resistivity, electroacoustic properties, energy bands, energy gap, energy levels, mobility, photoelectronic properties, photon electroluminescence, piezoelectric properties, reflectivity, refractive index, and thermal conductivity. G.D.B.

N64-27659 Autonetics, Anaheim, Calif.
EVALUATION OF THERMOCOMPRESSION BONDING PROCESSES
J. R. Howell and J. W. Slemmons Mar. 1964 36 p refs

Thermocompression bonding is the joining process commonly used for the interconnection of active semiconductor device and the output leads of the hermetic package that protect these delicate devices. A discussion of the most common thermocompression bonding processes is presented. Problem areas associated with the process are discussed; data are presented for a typical evaluation program that compares wedge and nailhead thermocompression bonding to aluminum metalized silicon and to silicon directly. Current and future requirements and applications are briefly discussed. Author

N64-27713 RAND Corp., Santa Monica, Calif.
STATISTICAL DESCRIPTIONS OF FREE BOSON FIELDS
Dennis Holliday Aug. 1964 21 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4103-PR; AD-603619)

This note demonstrates that using conventional stochastic process methods in the Heisenberg picture to describe a light beam produced by a statistical ensemble of classical (c-number) sources is equivalent to representing the statistical state of the light beam by a density matrix having a P-representation. The relation between the classical and quantum statistical descriptions implied by Sudarshan's probability functional approach is shown to be purely formal and without physical meaning. Sudarshan's statement that the probability functional method can be used to prove that all the correlation functions of the beam determine its density matrix is demonstrated to be incorrect. Author

N64-27724 Army Signal Research and Development Agency and Lab., Fort Monmouth, N.J.
ELECTROLUMINESCENT RESPONSE TO PULSE EXCITATION
Isidore H. Stein Apr. 1964 18 p refs
(USAELRDL-TR-2452; AD-601049)

Dissimilar electroluminescent cells were subjected to rectangular pulse excitation under varying parameters of pulse amplitude, pulse width, and repetition rate. Various aspects of the electroluminescent response to this excitation have been observed, such as the spectral response, high-pulse-voltage breakdown, visibility of light emission, and average brightness variation. A mathematical expression for average brightness under different parameters of pulse excitation was deduced. Author

N64-27737 Stanford U., Calif. Microwave Lab.
MICROWAVE RESEARCH Quarterly Status Report No. 21, 1 Feb.–31 Apr. 1964
C. F. Quate et al Jul. 1964 15 p ref
(Contract Nonr 225(48))
(ML-1192; AD-602967)

Reports are made on studies of the microwave region of acoustic wave amplification in piezoelectric semiconductors, the improvement and extension of the performance of optical masers, nonlinear microwave propagation in gyromagnetic media, diffraction of light waves by hypersound, and the force configuration on electrically neutral bodies in the presence of electromagnetic fields produced by high laser beams. A.W.

N64-27740* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
LOW-COVERAGE HEAT OF ADSORPTION. I—ALKALI METAL ATOMS ON TUNGSTEN; ATOM-METAL INTERACTION THEORIES
Harold E. Neustadter and Keung P. Luke Washington, NASA, Aug. 1964 13 p refs
(NASA-TN-D-2430) OTS: $0.50

A comparison of the experimental values of heat of adsorption (in the limit of zero coverage) for sodium, rubidium, and cesium on a tungsten substrate is made with those calculated from four different atom-metal theories. The best results are obtained from the theory developed by Prosen and Sachs, which takes into account the Fermi degeneracy of the electrons in the metal. Author

N64-27741* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
LOW-COVERAGE HEAT OF ADSORPTION. . II—ALKALI METAL ATOMS ON TUNGSTEN; LENNARD-JONES ATOM-ATOM INTERACTION THEORY
Harold E. Neustadter, Keung P. Luke, and Thomas Sheahan Washington, NASA, Aug. 1964 22 p refs
(NASA-TN-D-2431) OTS: $0.50

A comparison of experimental values of heat of adsorption (in the limit of zero coverage) for sodium, rubidium, and cesium on a tungsten substrate is made with those calculated from an adaptation of the Lennard–Jones atom–atom interaction potential to adsorption. A new method is presented for performing the necessary summations for three specific sites on the (100) and (110) planes, and comparisons are made with existing approximation methods. Author

N64-27742* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
LOW-COVERAGE HEATS OF ADSORPTION. III—ALKALI METAL IONS ON TUNGSTEN; ATOM-METAL INTERACTION THEORY
Harold E. Neustadter and Keung P. Luke Washington, NASA, Aug. 1964 10 p refs
(NASA-TN-D-2460) OTS: $0.50

The heat of adsorption of an ion on a metal (in the limit of zero coverage) is expressed as the superposition of a van der Waals-type interaction and an image charge-type interaction. The reported experimental values of the heat of adsorption of sodium, rubidium, and cesium ions on a tungsten substrate are then compared with results of a theoretical evaluation based on the above model. Author

N64-27747 Cornell U., Ithaca, N.Y. Lab. of Atomic and Solid State Physics
GENERALIZED CONTINUUM FIELD REPRESENTATIONS FOR LATTICE VIBRATIONS
James A. Krumhansl [1963] 25 p refs
(Contract Nonr-401(38))
(AD-441306)

Various representations of lattice displacement fields in the harmonic approximation are discussed. A method for defining a continuous field whose properties are systematically related to the lattice fields is developed. Using this method, the usual elastic continuum and couple-stress continuum approximations at long waves appear as the leading terms in a generalized continuum description of the harmonic lattice. The magnitude of the couple-stress effects can be estimated from molecular vibration data: at macroscopic wavelengths the couple-stress effects will be negligible in normal solids. Another application is the generalization of the method of long waves; this leads to "effective modulus" equations for arbitrary points K_0 in the BZ instead of just $K_0 = 0$. Application to study of extended defects is indicated. Author

N64-27770 International Business Machines Corp., Yorktown Heights, N.Y. Thomas J. Watson Research Center
PHONON INTERACTIONS IN CRYSTALS Third Quarterly Technical Report, 15 Nov. 1963–14 Feb. 1964
A. H. Nethercot, M. Pomerantz, and N. S. Shiren [1964] 27 p refs
(Contract DA-36-039-AMC-02280(E))
(Rept.-3; AD-601093)

Additional experimental work has been done on the measurement of the signal velocity of acoustic waves in an amplifying acoustic maser. Theory and experiment have previously shown that the signal velocity is decreased when the acoustic waves can interact with absorbing paramagnetic ions. Theory indicates a similar decrease even if the spin populations are inverted so that the ions are emitting. Experimental results at present indicate, on the contrary, that the signal velocity remains either unchanged or is increased in an amplifying acoustic maser. The temperature dependence of the attenuation of 9 Gc acoustic waves has been measured in a number of materials. These materials include magnesium oxide, silicon, germanium, quartz, sapphire, and calcium fluoride. Author

N64-27858 Michigan U., Ann Arbor College of Engineering
THE HYDROSTATIC PRESSURE EFFECT ON THE EPR SPECTRA OF CR^{3+} AND V^{2+} IN SAPPHIRE
Alan F. Clark, Richard H. Sands, and Chihiro Kikuchi May 1964 178 p refs
(Contract DA-49-186-AMC-80(X))
(Rept.-06029-1-T; AD-601961)

The interaction of the CR^{3+} and V^{2+} impurity ions with the α-Al_2O_3 crystal lattice was studied by observing the hydrostatic pressure dependence of their electron paramagnetic resonance spectra to 6,000 atm. A two-sample comparison method was used in which two identical samples are placed in the X-band microwave resonant cavity. One end of the cavity and one sample are subject to hydrostatic pressure. The changes in the spin Hamiltonian parameters are obtained by measuring the difference in the magnetic field required for the same resonant condition in each sample as a function of pressure. Author

26 PROPELLANTS AND COMBUSTION

Includes fuels; igniters; and oxidizers. *For related information see*: 07 Chemistry; and 27 Propulsion.

N64-27225* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
THE X-IRRADIATION OF HYDRAZINE AND 1,1–DIMETHYLHYDRAZINE
Harold Lucien and Murray L. Pinns Washington, NASA, Aug. 1964 13 p refs
(NASA-TN-D-2452) OTS: $0.50

Hydrazine and 1,1-dimethylhydrazine were radiolyzed at room temperature by using about 1 gram of liquid or 1/2 to 2 liters of vapor at room-temperature vapor pressure. A tungsten-target X-ray source operating at 300 kv and 6 to 8 ma (0.1 to 1.0 A) was used at intensities of 1×10^2 to 1×10^3 roentgens per minute to give total doses of 4.1 rads to 2.3×10^6 rads. The amounts of decomposition were dependent on total dose and independent of dose rate. In the case of hydrazine vapor, the decomposition was also directly related to surface area. There was a lesser surface effect with liquid hydrazine, but this variable was not studied for 1,1-dimethylhydrazine. The order of decreasing sensitivity to X-radiation is hydrazine vapor, 1,1-dimethylhydrazine vapor, 1,1-dimethylhydrazine liquid, and hydrazine liquid. The decomposition products of hydrazine were nitrogen, hydrogen, ammonia, and unidentified products. The same products plus methylamine, dimethylamine, and hydrazine were found from the decomposition of 1,1-dimethylhydrazine. In addition, the 1,1-dimethylhydrazine underwent postirradiation changes. Values for G (number of molecules of sample decomposed per 100 ev of absorbed energy) of the order of 10^6 suggest that the vapor-phase decompositions are chain reactions.
Author

N64-27231* National Aeronautics and Space Administration, Washington, D.C.
EFFECT OF ERRATIC (UNSTEADY) COMBUSTION CONDITIONS AND ROTATION OF A ROCKET ON THE MAIN VECTOR AND ON THE PRINCIPAL MOMENT OF REACTIVE FORCES [VLIYANIYE NEUSTANOVIVSHEGOSYA REZHIMA GORENIYA I VRASHCHENIYA RAKETY NA GLAVNYY VEKTOR I GLAVNYY MOMENT REAKTIVNYKHSIL]
V. S. Novoselov Jul. 1964 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 1, 1964 p 101–103
(NASA-TT-F-9041)

The internal motion of particles in a combustion chamber and in a jet is considered. The motion of these particles is the principal vector and the principal moment of reactive forces. Equations are given that describe the motion and the kinetic moment of these particles. Equations are also given for the principal vector and the principal moment of the Coriolis forces. The formulas for computing the moments are valid relative to any point of a rigid system connected with the combustion chamber. As an example of the use of these formulas, the case of the motion of a rocket propelled by a liquid jet engine is considered.
R.T.K.

N64-27287* Princeton U., N.J. Guggenheim Labs. for the Aerospace Propulsion Sciences
NONLINEAR ASPECTS OF COMBUSTION INSTABILITY IN LIQUID PROPELLANT ROCKET MOTORS Fourth Yearly Progress Report, 1 Jun. 1963–31 May 1964
David T. Harrje and William A. Sirignano 1 Jun. 1964 207 p refs
(Contract NASr-217; Grant NsG-99-60)
(NASA-CR-56946; Rept.-553-d)

Theoretical studies were made of the nonlinear oscillations that commonly occur in rocket combustion chambers and exhaust nozzles. Both the longitudinal and transverse mode of combustion instability were analyzed. The results of experimental studies of nonlinear combustion-instability mechanisms are presented. These include transverse mode, nonlinear, rocket-motor studies; longitudinal, nonlinear rocket studies using the square motor; the vapor-displacement mechanism; and basic experiments in droplet resonant phenomena. The mechanism for combustion instability in droplet and wake burning is discussed; and the original time-lag theory of Crocco and Cheng is extended to include higher order Mach-number effects.
R.T.K.

N64-27342 Library of Congress, Washington, D.C. Aerospace Technology Div.
NEW COMBUSTION PROCESSES Surveys of Soviet-Bloc Scientific and Technical Literature, 1958–Jan. 1964
17 Aug. 1964 52 p refs
(ATD-P-64-49)

The purpose of this report is to present material related to unconventional combustion processes that might be used in the development of hypersonic ramjet and supersonic combustion processes. A literature search revealed one article directly related to shock-induced combustion and several articles on a new detonative combustion process. Other sections deal with subjects indirectly related to shock-induced combustion, such as reaction kinetics, ignition delays, and some shock and detonation wave characteristics. A general survey and discussion of studies in the field of detonation research and related subjects are presented. High-velocity diffusional combustion is not covered.
Author

N64-27454 General Electric Co., Philadelphia, Pa. Spacecraft Dept.
PROPELLANT STORABILITY IN SPACE Final Report, 15 May 1963–30 Jun. 1964
W. Benton, R. Carr, A. Cohen, G. Gustafson, C. Lankton, and B. Zeldin Edwards AFB, Calif., Rocket Propulsion Lab., Jun. 1964 207 p refs
(Contract AF 04(611)-9078)
(RPL-TDR-64-75; AD-603215)

Presented here are the results and interpretation of tests performed in the space environmental simulator to investigate storability of propellants in space. The purpose of the work is to demonstrate the long-term storage capability of cyrogenic and earth storable propellants in a simulated orbital environment. Tanks of various sizes and shapes were tested. The test articles included a simulated meteorite shield and employed advanced support techniques suitable for a low g environment. A simulated sun was used as the source of heat input. The sun was cycled to represent the conditions in a high-inclination, low-altitude earth orbit. The test results were analyzed and related to the storage of actual propellants.
Author

N64-27548 Stanford Research Inst., Menlo Park, Calif.
VISCOELASTIC PROPERTIES OF SOLID PROPELLANTS AND PROPELLANT BINDERS Quarterly Technical Summary Report No. 3, Jan. 16–Apr. 15, 1964
Nicholas W. Tschoegl, James R. Smith, and Thor L. Smith 15 May 1964 19 p
(Contract NOw-64-0073-d; ARPA Order 22)
(Rept.-11; AD-443509)

Experiments were carried out with the low-frequency dynamic shear tester on unfilled styrene–butadiene rubber specimens to determine how the observed complex modulus depends on the laterally applied clamping force, specimen size, and cam displacement. The experiments proved the suitability of the differential Lissajous method for the precise determination of small phase angles. Above about 60 pounds, the results were sensibly independent of clamping force. The dependence of the modulus on specimen size and

cam displacement appeared to result from nonlinear viscoelastic effects. The current state of development of the dynamic bulk compressibility apparatus and the static (isothermal) compressibility apparatus is discussed. Author

N64-27563 Toronto U. (Canada) Inst. for Aerospace Studies
AN EXPERIMENTAL INVESTIGATION OF SPHERICAL COMBUSTION FOR THE UTIAS IMPLOSION DRIVEN LAUNCHER
André Benoit Sep. 1963 155 p refs
(Contract AF-33(657)-7874)
(UTIAS-TN-71; AD-442951)

An experimental investigation of the combustion processes occurring in the UTIA implosion driven hypervelocity launcher combustion chamber was conducted in stoichiometric mixtures of hydrogen–oxygen diluted with an excess of hydrogen or helium. The mixtures were ignited using a spark gap or an exploding wire at the geometric center of the hemispherical vessel, and piezopressure gage histories were recorded for various dilutions and initial pressures ranging from 75 to 1,000 psi. Heat-transfer and ionization gages were used to measure average combustion wave speeds and to investigate the wave symmetry. Calculations of the final conditions after complete combustion (constant volume combustion assuming no dissipative effects) were accomplished taking dissociations into account. The derived pressures were compared with those obtained experimentally. Author

N64-27566 Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.
SOLUTION AND CONDUCTIVITY STUDIES IN FLUORINE-CONTAINING LIQUID OXIDIZERS Quarterly Progress Report, 10 Mar.–15 Jun. 1964
M. S. Toy, W. A. Cannon, and W. D. English Jul. 1964 44 p refs
(Contract DA-31-124-ARO(D)-115; ARPA Order-470)
(Rept.-144-Q4; AD-443504)

This is a report on solution and conductivity studies in fluorine-containing liquid oxidizers. Oxidizers were purified by low temperature fractionation column and analyzed by gas chromatograph. Conductivity and miscibility studies were extended to additional oxidizers. Photolysis and temperature effects on conductivity of oxidizers were studied. A conductivity increase of over a hundredfold was achieved for nonconducting oxidizer through ultraviolet illumination. Author

N64-27570 General Motors Corp., Santa Barbara, Calif. Defense Research Labs.
APPROXIMATE THERMODYNAMIC FUNCTIONS FOR THE H_3O^+(g), HCO^+(g), AND CH_3^+(g) IONS
David G. Clifton Jul. 1964 25 p refs
(Contract DA-04-495-ORD-3567(Z); ARPA Order 357-63; Proj. Defender)
(TRG4-02D; AD-444078)

Approximate values for the free-energy function, enthalpy function, entropy, and constant-pressure heat capacity have been calculated for the ions H_3O^+(g), HCO^+(g), and CH_3^+(g). A structural analysis of the ions based upon chemical valence considerations leads to the estimation and assignment of the spectroscopic constants, which are then used for the statistical thermodynamic calculations. Author

N64-27615 North American Aviation, Inc., Los Angeles, Calif. Avionics Group
SPECTRAL EMISSIVITY OF FLASH COMBUSTION REACTION STUDY PROGRAM Final Technical Report, 1 Jun. 1963–31 May 1964
J. M. Gerhauser 6 Jul. 1964 161 p refs
(Contract Nonr-4236(00); ARPA Order 306-62; Proj. Defender)
(NA-64-608; AD-443158)

Brightness temperatures were achieved that were adequate to pump neodymium and ruby lasers. The highest temperature was achieved with hafnium and potassium perchlorate, (about 6,500° K). Zirconium and potassium perchlorate reaction produced temperatures almost as high as hafnium and thorium. It was found that the best use of chemical reactions for pumping lasers is to use the low- or medium-pressure techniques. The characteristics and the potential of pyrotechnic reactions for pumping lasers were established. R.T.K.

N64-27735 Stanford Research Inst., Menlo Park, Calif.
SOLID PROPELLANT MECHANICAL PROPERTIES INVESTIGATIONS Quarterly Progress Report No. 1, Oct. 1, 1963–Jan. 1, 1964
Norman Fishman and James A. Rinde 20 Jan. 1964 21 p refs
(Contract AF 04(611)-9559)
(Rept.-3; AD-602531)

Progress has been made toward achieving a major objective of this research, i.e., the development of a method for defining the path-independent physical state of a propellant in terms of stress–strain–time history. The applicability of an "equation of state" to constant strain rate and constant load test results is demonstrated by comparison of calculated and experimental test data at three temperatures. The general form of the equation being evolved is: $\log V/V_o = A[\log W + B (\log t - \log b_T)]^n$ where W is strain energy as expressed by the area under the stress–strain curve, t is the time in minutes, and $\log b_T$ is a temperature shift factor. Preliminary tests under conditions of constant loading rate, constant strain rate cycling, and constant load recovery were undertaken, and results are reported. Author

N64-27743 Canadian Armament Research and Development Establishment, Valcartier
A PULSE TECHNIQUE FOR THE EVALUATION OF COMBUSTION INSTABILITY IN SOLID PROPELLANT ROCKET MOTORS
E. P. Morris Jun. 1964 17 p refs
(CARDE-TR-487/64)

In the early stages of the development of ammonium perchlorate polyurethane solid propellants, unstable combustion in the finite-wave axial mode was occasionally experienced. Although the evaluation of engine characteristics by firing a statistically satisfactory number of small motors is feasible, stability of the motor when scaled up to a larger size is not assured. To provide a positive method for testing and evaluating instability by a minimum number of firings, a pulse technique employing small gunpowder charges was developed to initiate unstable combustion when the motor is operating in an incipiently unstable regime. This pulse technique is an essential requirement for definitive testing, since an inherently unstable motor will operate stably if no triggering flow disturbance occurs during the firing. The method permits a systematic study of the phenomenon. The pulse technique and the devices are described, and some of the general results obtained from the investigations are presented. The technique has been used successfully for rocket motors, heavy walled and flight type, from 2 in. to 17 in. in diameter. Author

27 PROPULSION

Includes airbreathing, electric, liquid, nuclear, and solid propulsion. *For related information see*: 04 Aircraft; 06 Auxiliary Systems; 26 Propellants and Combustion; and 30 Space Vehicles.

N64-26993* RAND Corp., Santa Monica, Calif.
A STUDY OF ELECTRICAL PROPULSION IN THE SPACE PROGRAM
B. Pinkel and D. L. Trapp *In* NASA. Marshall Space Flight Center Proc. of the Symp. on Manned Planetary Missions, 1963/1964 Status 12 Jun. 1964 p 687–736 (See N64-26979 19-29)
(Contract NAS8-11081) OTS: $31.00 ph

The study of the place of electrical propulsion in the space program led to the following conclusions: (1) A $3 billion, 12-year development program on an electrical propulsion system would provide a system of only moderate proven reliability. (2) High mission reliability can be obtained by designing for the contingency of a substantial degradation in jet power. In low-acceleration trajectories, completion of a mission, in the event of loss of power, can be accomplished by increasing travel time and/or by redundancy in propulsion system equipment. (3) In the Mars mission with a longer round-trip time (e.g., roughly 100 days) allowed for the electrically propelled vehicle relative to the optimum trip time for the nuclear rocket propelled vehicle, the electrical system promises a substantially lower trip cost than the nuclear rocket. P.V.E.

N64-27214 General Motors Corp., Indianapolis, Ind. Allison Div.
CONTROLLABLE CLUSTERED NOZZLES
[1963] 92 p
(RN-62-24)

An approach to full-thrust directional control with fixed geometry engines is described. This approach involves the use of a cluster of four (or more) variable thrust rockets with their thrust axes so aligned that they do not pass through either the vehicle center of gravity or roll axis. Proper selection of the alignment of the four motors provides three sets of forces that can produce couples about the roll, pitch, and yaw axes. When the thrust of all four chambers is equal, the couples cancel and there is no disturbance on the vehicle. When a couple is required for directional or maneuvering control, the chambers for the appropriate couples are unbalanced and a control moment is provided. From the above experiments these conclusions were drawn: (1) Fixed geometry nozzle clusters can be designed to provide adequate control for vehicle control when used with multiple variable-thrust chambers. (2) The performance of vehicles using fixed-geometry clusters may exceed the performance of similar vehicles using conventional thrust-vector-control techniques. (3) No single nozzle type is optimum for all vehicle applications or missions. A.L.B.

N64-27277* Boeing Co., Seattle, Wash. Aero-Space Div.
INVESTIGATION OF VEHICLE-INTEGRATED ROCKET POWERPLANTS WITH AIR AUGMENTATION, VOLUME I Final Report, 29 Jun. 1963–15 Jun. 1964
15 Jun. 1964 141 p refs
(Contract NAS8-11017)
(NASA-CR-56890) OTS: $11.50

The purpose of the study was to analytically assess the feasibility of improving launch vehicle performance by means of an air augmented rocket propulsion system. To this end, three computer programs were developed or modified and extensively used during the course of the investigation. A one-dimensional augmented engine cycle analysis program was written in order to investigate performance trends and to outline those areas not warranting further analysis. An existing perfect gas, frozen composition, method of characteristics nozzle plume program was revised to describe the inviscid interaction between a supersonic plume and an isentropic one-dimensional stream confined by a wall. A finite difference mixing program was developed that accounts for axial pressure gradient, equilibrium chemistry, and confinement of the secondary stream by a duct wall. Author

N64-27282* Electro-Optical Systems, Inc., Pasadena, Calif.
DESIGN STUDY OF A SOLAR HYDROGEN PROPULSION AND POWER SYSTEM Final Report, 17 May–16 Nov. 1963
F. Mc Farlane, B. Kalensher, B. Wilner, and E. Findl 23 Jul. 1964 134 p
(Contract NAS7-231)
(NASA-CR-56977; EOS-4000-Final) OTS: $10.50 ph

This design study contains 7 chapters as follows: (1) "Introduction"; (2) "Summary and Recommendations"; (3) "Performance Analysis of Components"; (4) "Design Study of Combined Cavity Absorber"; (5) "Deployment, Initial Orientation, and Station Keeping"; (6) "Design for a 24-Hour Satellite System", and (7) "Mission Studies." A.W.

N64-27288* Boeing Co., Seattle, Wash. Aero-Space Div.
AIR AUGMENTED ROCKET (ONE-DIMENSIONAL), REFERENCE NUMBER AS 1961. COMPUTING FACILITY, IBM 7094
Forney M. Knox [1964] 104 p refs
(Contract NAS8-11017)
(NASA-CR-56842) OTS: $9.10

This computer program calculates the additional thrust obtained by adding air, in a postchamber mixing section, to the fuel-rich exhaust gases of a rocket engine. It may be used with a wide range of fuels composed of up to 15 elements. Three assumptions are made—there is complete mixing of the exhaust and the augmenting streams, chemical equilibrium is achieved, and the augmenting stream is a perfect gas. Author

N64-27377* Lockheed Aircraft Corp., Sunnyvale, Calif.
LAUNCH OPERATIONAL TEST PLAN. SECTION 1: CHECK-OUT AND LAUNCH PLAN
L. L. Woodward 31 Mar. 1964 85 p refs
(Contracts NAS8-5600; NAS8-9500)
(NASA-CR-56671; NSP-62-43, Rev. 2) OTS: $8.10 ph

The checkout and launch plan is a planning aid covering typical operations for all flights. Sequence of events from receipt of stage through launch are included. Activities in each functional checkout area, including time spans and schedules, are detailed. In addition, data requirements, data acquisition, command systems functions, range support, and postflight operations are described. N.E.A.

N64-27514 Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genèse (Belgium)
APPROXIMATE ANALYTICAL SOLUTION FOR LOW THRUST PROPULSION IN SPACE
L. Moulin May 1964 42 p refs
(Grant AF-EOAR-63-39)
(VKI-TN-16)

Approximate analytical solutions are derived for the problem of low thrust propulsion, in the case of constant thrust, set at a constant angle to the velocity vector, for any type of initial orbit (elliptic, parabolic, or hyperbolic). Simple expressions are obtained, giving energy, angular momentum, and eccentricity in terms of the eccentric anomaly. The solutions allow for calculation of the fuel consumption. Their validity is restricted to the field of orbit correction. Author

28 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. *For related information see*: 05 Astronomy and Astrophysics; 16 Life Sciences; and 29 Space Sciences.

N64-27077 High Altitude Observatory, Boulder, Colo.
OCCURRENCES OF THE YELLOW CORONAL LINE, MAY 1, 1957–MAY 31, 1964
Dorothy E. Trotter and De Arliss Henderson 3 Aug. 1964 12 p refs
(IGY Solar Act. Rept. Ser.-27)

This is a compilation of the yellow line observations made at Sacramento Peak, New Mexico, and Climax, Colorado, observatories during the IGY-IGC period and the remainder of the solar cycle ended at time of publication. The tables presented give, for each observation of the yellow line emission, the date; the heliographic position angle measured from solar north (0°) toward the east; the time in universal hours and minutes at which the spectrum was made; the intensity in five qualitative categories—very faint, faint, moderate, bright, and very bright; and the station at which the event was observed. R.T.K.

N64-27185 Nagoya U. (Japan) Research Inst. of Atmospherics
ELEVEN-YEAR VARIATION OF THE SPECTRUM OF SOLAR RADIO EMISSION ON THE MICROWAVE REGION
Haruo Tanaka *In its* Proc. of the Res. Inst. of Atmospherics, Nagoya U., Vol. II Jan. 1964 p 41–51 refs (See N64-27180 19-12)

Daily values of flux density at four frequencies on a microwave region observed at Toyokawa for more than half of a complete solar cycle were reviewed, and some corrections were made for 9400 and 2000 mc. Basic components were estimated with the aid of interferometric observations as well as by statistics. It was found that the 11-year change of the basic components amounts to 3.0, 1.56, and 1.13 times the quiet sun levels for 1000, 2000, 3750 and 9400 mc, respectively. The spectrum of the slowly varying component changes appreciably during the solar cycle. Author

N64-27189 American Meteorological Society, Boston, Mass.
METEOROLOGICAL AND GEOASTROPHYSICAL ABSTRACTS, VOLUME 14, NUMBER 11, NOVEMBER 1963
Malcolm Rigby, ed. Nov. 1963 376 p refs
(Supported by NASA, DOD, WB, NSF)

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2. RECENT LITERATURE ON COSMIC RADIATION, 1962–1963 p 3655–3710 refs (See N64-27190 19-28)

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4. AUTHOR AND SUBJECT INDEXES p 3743–3767

N64-27190 American Meteorological Society, Boston, Mass.
RECENT LITERATURE ON COSMIC RADIATION, 1962–1963
Elemer Kiss *In its* Meteorol. and Geoastrophys. Abstracts, Vol. 14, No. 11, Nov. 1963 p 3655–3710 refs (See N64-27189 19-28)

This annotated bibliography on cosmic radiation is limited to articles on cosmic rays in the atmosphere or at or below the earth's surface, and on the equipment or methods of observation of cosmic rays. The following subjects are included in the bibliography: (1) chemical and physical composition of cosmic rays; (2) sources of influences on cosmic rays; (3) instruments and instrument carriers; and (4) the International Geophysical Year. R.T.K.

N64-27213 General Electric Co., Oklahoma City, Okla. Military Communications Dept.
ESTIMATED NUCLEAR RADIATION ENVIRONMENT RADIATION EFFECTS
J. L. Andrews 10 Feb. 1964 86 p refs
(R64MCD-501)

This report is an investigation of the penetrating radiation environment incident upon Nimbus B satellites in several possible orbits. A general survey of the energetic radiation environment near the earth is presented. Fluxes are determined for five 6-month, polar, circular orbits at altitudes from 540 to 1,500 nmi. Estimates are given for fluxes and absorbed doses within spherical aluminum shields of 100- and 200-mil thickness (typical minimum protection for electronics); additional estimates of the absorbed dose from one extreme-size nuclear detonation similar to the Starfish one are also presented. Author

N64-27247* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THEORETICAL STUDIES OF PROTONS IN THE OUTER RADIATION BELT
M. P. Nakada, J. W. Dungey (Imperial Coll. of Sci. and Tech.), and W. N. Hess May 1964 14 p refs
(NASA-TM-X-55007; X-640-64-110) OTS: $1.60 ph

The variations in the energy spectra with pitch angle and L of the relatively stable 0.1 to 5 Mev protons in the outer radiation belt were in good agreement with the results of a model that permits rapid motion of the protons in L space. In this model, the protons violate the third adiabatic invariant of trapped particle motion but do not violate the first two adiabatic invariants. Changes in fluxes with L are not consistent with Liouville's theorem. Both the departure from Liouville's theorem and variations in energy spectra seem to indicate that the source of these protons is at large L. Author

N64-27250* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR CYCLE CHANGES IN INNER ZONE PROTONS
Robert C. Blanchard and Wilmot N. Hess Mar. 1964 33 p refs
(NASA-TM-X-55013; X-640-64-50) OTS: $3.60 ph

Time-dependent calculations of the inner Van Allen belt proton population show that large changes of the population up to a factor of 50 will take place during the solar cycle. The effect is most pronounced for the region of B-L space corresponding to minimum altitudes of 300 to 700 km. Because different energy protons respond to the changing solar cycle at different rates, the proton energy spectra will change with time also. Author

N64-27363* Consultants and Designers, Inc., Arlington, Va.
ON THE INTENSITY AND POLARIZATION OF SOLAR CORONA'S FORBIDDEN LINES
Pierre Charvin 22 Jul. 1964 7 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci., Phys. Solaire (Paris), v. 258, No. 4, 27 Jan. 1964 p 1155–1158
(Contract NAS5-2078)
(NASA-TT-F-8930; ST-SP-10179)

The general expression of intensities $I_{\parallel}$ and $I_{\perp}$ of forbidden lines stemming from the corona's element of volume in the absence of a magnetic field is given. Calculations are then developed in the case of a two-level basic configuration, which makes it possible to find again, in a most extended form, the results established for the optical resonance radiation. Author

N64-27443 Plasmadyne Corp., Santa Ana, Calif.
STUDY OF RADIATION FROM VORTEX STABILIZED ARCS
Delbert G. Van Ornum Arnold Eng. Develop. Center, Tenn., Aug. 1964 83 p refs
(Contract AF 40(600)-1033)
(AEDC-TDR-64-165; AD-603519)

The purpose of this study was to determine the radiation properties of the vortex stabilized arc plasma using the inert gases in a closed gas recirculating system. It was found that high-intensity, 10-kw to 60-kw, vortex arcs radiate in an ultraviolet peaked continuum with relatively weak line radiation superimposed and largely confined to the infrared. Data on spectral power distribution, microradiancy, total radiant power, and its spatial distribution are presented. The vortex arc is essentially cylindrical, but its shape and the spatial distribution of its radiation can be modified by electrode design to better match a selected optical system. Author

N64-27661* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TEMPERATURE OF A GRAY BODY MOST CLOSELY FITTING THE SOLAR EXTRATERRESTRIAL SPECTRUM
William B. Fussell and John B. Schutt Washington, NASA, Aug. 1964 11 p ref
(NASA-TN-D-1845) OTS: $0.50

A definition of closeness of fit of a gray body curve to the sun's extraterrestrial spectrum is presented. F. S. Johnson's data are used for the solar spectrum. For the wavelength interval 0.3μ to 2.4μ (pertinent to thermal design), the magnitude of C_1 calculated for use in Planck's blackbody formula is 8.6504×10^{-17} watt-cm^2 at a temperature of 5,742 $\pm$0.5° K. Author

N64-27664* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SIMPLE MODEL OF THE INTERPLANETARY MAGNETIC FIELD. PART 2: THE COSMIC RAY ANISOTROPY
David Stern Washington, NASA, Aug. 1964 14 p refs
(NASA-TN-D-2404) OTS: $0.50

Three explanations for the observed cosmic ray anisotropy were investigated. The possibility that the anisotropy is due to trapped orbits in the interplanetary magnetic field is explored by analyzing the motion of charged particles in the stretched dipole field. An anisotropy is possible, but only when several unlikely conditions are met. Two other theories of the anisotropy, ascribing it to a sunward flux density gradient or to the Compton–Getting effect, are then discussed. In general, both effects occur together; for conservative fields they cancel each other and no anisotropy occurs, as indeed might be expected from Liouville's theorem. Consequently, any gradient of cosmic ray flux density that might be measured in interplanetary space is not necessarily connected with the observed anisotropy. Author

N64-27665* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DIRECTIONAL DEPENDENCE OF COUNTING RATES FROM EXPLORER IV (SATELLITE 1958 EPSILON)
Robert Jordan Naumann Washington, NASA, Dec. 1963 79 p refs
(NASA-TR-R-168) OTS: $2.00

Inspection of the directional scintillation counter data from Explorer IV revealed fluctuations in the counting rate that appeared to be due to the body motions of the satellite and the anisotropy of the radiation flux. The body motions and the angular dependence of the radiation flux could be determined from the data available. This work is a description of the methods used and results obtained from this determination. The counting rate is generally a maximum when the detector axis is normal to the magnetic field, which is expected from the theory of particle trapping. The counting rate falls off as the detector axis makes smaller angles with the magnetic field lines, reaching a minimum value when the detector comes within about 40° of the magnetic field lines. Knowledge of this angular dependence of the counting rate will allow calculation of the radiation distribution along a particular magnetic line of force. In the analysis of the rigid body motion, two rather surprising facts were observed. First, the components of the total angular momentum vector of the satellite do not remain constant in a space orientation-fixed reference system, although the magnitude remains essentially constant. Second, the small residual roll of the satellite about its longitudinal axis does not decay monotonically. In fact, at one point, the roll rate increased by almost an order of magnitude in one day. These two observations suggest that external forces are present and exert body torques on the satellite. It is possible that the origin of the forces may be due to an interaction of a magnetic moment in the satellite with the geomagnetic field, although this is not yet confirmed. Author

N64-27697 Hughes Aircraft Co., Fullerton, Calif.
RADIATION EFFECTS ON GUIDED MISSILE ELECTRONIC EQUIPMENT Final Technical Report, 15 Jul. 1963-15 Jan. 1964
J. E. Bell [1964] 276 p refs
(Contract NOw-63-0486-d)
(FR-64-17-41; AD-601457)

This report includes (1) electron and gamma correlation and a definition of the laboratory environment; (2) radiation effects on thin film devices, bulk semiconductor integrated devices and circuits, silicon controlled rectifiers, resistors, and the correlation of transistor response with electrical parameters; (3) general circuit hardening techniques, and the development of a silicon controlled rectifier equivalent model for radiation prediction techniques; and (4) radiation effects on nonlinear circuits employing silicon controlled rectifiers, four layer diodes, trigisters, and gate turnoff switches. Author

N64-27805* Cornell U., Ithaca, N.Y. Center for Radiophysics and Space Research
MAGNETIC EFFECTS OF GEOMAGNETICALLY TRAPPED PARTICLES
Martin Lester Dwarkin May 1962 52 p refs
(NsG-184-60; Contract AF 49(638)-915)
(NASA-CR-58056; CRSR-117; AFOSR-3003) OTS: $5.60 ph

Particle motion around the equatorial plane in the trapping region is the principal source of magnetic field due to trapped particles. The magnetic field throughout the earth is due to particles trapped on dipole shells for which $a > 2.5$ is essentially uniform. It seems likely that the majority of particles responsible for magnetic storms are trapped on dipole shells for which $1.3 \leq a \leq 2.5$ with a maximum concentration of particles around the dipole shell with $a \approx 1.7$. Author

N64-27810* Polytechnic Inst. of Brooklyn, Freeport, N.Y.
RADIATION PROCESSES OF CHARGED PARTICLES MOVING IN THE UPPER ATMOSPHERE, AND COMPOSITION AND PROPERTIES OF THE MAGNETOSPHERE
Final Report, 1 May 1962–30 Apr. 1963
May 1963 4 p
(Grant NsG-165-61)
(NASA-CR-56721) OTS: $1.10 ph

This report summarizes four problems—radiation from a rotating point charge, thermionic screening of hot objects in planetary atmospheres and interplanetary space, photoelectric screening of hot objects in interplanetary space, and modification of the geomagnetic field by the magnetic moment of the earth's radiation belt. G.D.B.

29 SPACE SCIENCES

Includes space chemistry; cosmology; lunar and planetary exploration; and theoretical analysis of orbits and trajectories. *For space biology see*: 16 Life Sciences. *For related information see*: 05 Astronomy and Astrophysics; 12 Geophysics; and 22 Navigation and Guidance.

N64-26979* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
PROCEEDINGS OF THE SYMPOSIUM ON MANNED PLANETARY MISSIONS, 1963/1964 STATUS
12 Jun. 1964 744 p refs Symp. Held at Huntsville, 28–30 Jan. 1964
(NASA-TM-X-53049) OTS: $31.00 ph

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3. AMES RESEARCH CENTER MARS MISSION STUDIES INTRODUCTION C. A. Syvertson (NASA. Ames Res. Center) p 141–148 (See N64-26982 19-29)

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6. MANEUVERABLE DESCENT SYSTEMS FOR MARS LANDING R. N. Worth (Northrop Corp.) p 245–267 (See N64-26985 19-29)

7. AMES RESEARCH CENTER MARS MISSION STUDIES SUMMARY H. Hornby (NASA. Ames Res. Center) p 269–278

8. A STUDY OF MANNED MARS EXPLORATION IN THE UNFAVORABLE TIME PERIOD (1975–1985) R. N. Austin (Gen. Dyn./Ft. Worth) p 279–345 refs (See N64-26986 19-29)

9. MANNED MARS EXPLORATION IN THE UNFAVORABLE (1975–1985) TIME PERIOD R. L. Gervais (Douglas Aircraft Co.) p 347–403 (See N64-26987 19-29)

10. SUBSYSTEMS REQUIREMENTS FOR A MARS MISSION MODULE A. L. Jones (N. Am. Aviation) p 405–440 (See N64-26988 19-32)

11. STUDY OF A MANNED MARS EXCURSION MODULE F. P. Dixon (Philco Corp.) p 441–523 (See N64-26989 19-32)

12. PRELIMINARY DESIGN OF A MARS-MISSION EARTH REENTRY MODULE D. J. Shapland (Lockheed Missiles and Space Co.) p 525–576 refs (See N64-26990 19-32)

13. A PLANETARY TRANSPORTATION MODEL AND ITS APPLICATION TO SPACE PROGRAM PLANNING G. W. Morgenthaler (Martin Co.) p 577–609 (See N64-26991 19-29)

14. A STUDY OF THE DEVELOPMENT OF A BASIC PLANETARY TRANSPORTATION SYSTEMS MODEL K. A. Ehricke (Gen. Dyn./Astronautics) p 611–685 (See N64-26992 19-29)

15. A STUDY OF ELECTRICAL PROPULSION IN THE SPACE PROGRAM B. Pinkel and D. L. Trapp (RAND Corp.) p 687–736 (See N64-26993 19-27)

N64-26980* General Dynamics/Astronautics, San Diego, Calif.
A STUDY OF MANNED INTERPLANETARY MISSIONS
K. A. Ehricke *In* NASA. Marshall Space Flight Center, Proc. of the Symp. on Manned Planetary Missions, 1963/1964 Status 12 Jun. 1964 p 7–74 (See N64-26979 19-29)
(Contract NAS8-5026) OTS: $31.00 ph

The study of manned interplanetary missions included consideration of the following: mission analysis, interplanetary-vehicle survey, vehicle design, fuel conservation and meteoroid protection; life-support systems, interplanetary-vehicle weight analysis, earth launch vehicles, ground handling and launch operations, launch requirements, and orbital assembly operations. P.V.E.

N64-26981* Lockheed Missiles and Space Co., Sunnyvale, Calif.
MANNED INTERPLANETARY MISSIONS
B. P. Martin *In* NASA. Marshall Space Flight Center Proc. of the Symp. on Manned Planetary Missions, 1963/1964 Status 12 Jun. 1964 p 75–140 (See N64-26979 19-29)
(Contract NAS8-5024) OTS: $31.00 ph

The following are discussed with respect to manned interplanetary missions: (1) missions—short stopovers on a satellite orbit, single-launch flyby trajectories passing both Mars and Venus, and flybys passing only one planet; (2) earth-orbit launch constraints—hyperbolic escapes; (3) crew utilization and requirements—ionizing radiation, physicochemical regeneration, and trace-contaminant control; (4) guidance and control—injection into heliocentric trajectory, midcourse correction, planet approach, and stopover orbits; (5) reconnaissance—integrated systems of data sensing, processing, correlation, and evaluation; (6) power systems—recommendation of

onboard electrical powerplants for three-man Mars–Venus flyby spacecraft; (7) spacecraft design—solar concentrator and nuclear heat sources; (8) orbit launch vehicles—the applicability of future or possible Saturn-class orbit and ground launch boosters to interplanetary missions; (9) schedules of operational events—salient flyby mission milestones; (10) development planning—consideration of early Mars and Venus manned flyby missions; and (11) cost and funding schedule—preliminary cost analysis of an early manned Mars and Venus flyby mission. P.V.E.

N64-26982* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

AMES RESEARCH CENTER MARS MISSION STUDIES INTRODUCTION

C. A. Syvertson *In* NASA. Marshall Space Flight Center Proc. of the Symp. on Manned Planetary Missions, 1963/1964 Status 12 Jun. 1964 p 141–148 (See N64-26979 19-29) OTS: $31.00 ph

Studies having the following objectives are outlined: (1) determination of the technical feasibility of landing and return missions; (2) conducting trade-off studies of principal parameters and modes; (3) establishment of the characteristics of the most promising concepts; and (4) exposure of technical problem areas. P.V.E.

N64-26983* Space Technology Labs., Inc., Los Angeles, Calif.

SUMMARY OF MANNED MARS MISSION STUDY

R. L. Sohn *In* NASA. Marshall Space Flight Center Proc. of the Symp. on Manned Planetary Missions, 1963/1964 Status 12 Jun. 1964 p 149–219 ref (See N64-26979 19-29) OTS: $31.00 ph

The general goals of the study were to establish system trade-offs between mission modes, to evaluate and compare general approaches to key technical problems, and to identify and recommend technological area for long-range research. The first phase of the study was concerned with the definition of basic mission modes. The initial studies also included analyses of crew requirements and utilization, Mars landing-party functions and operations, and a computer simulation of an onboard navigation system, which gave an accurate evaluation of achievable entry corridors at Mars and Earth along with midcourse corrections necessary to achieve the corridors. Succeeding activities were concerned with analyzing and comparing the various mission modes. Selected design problems were analyzed, including provisions for artificial gravity and for economical arrangements for achieving acceptable solar-radiation protection. P.V.E.

N64-26984* North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.

MANNED MARS LANDING AND RETURN MISSION STUDY

A. L. Jones *In* NASA. Marshall Space Flight Center Proc. of the Symp. on Manned Planetary Missions, 1963/1964 Status 12 Jun. 1964 p 221–244 (See N64-26979 19-29)
(Contract NAS2-1408) OTS: $31.00 ph

Several of the significant factors influencing the design of the manned modules and propulsion modules are discussed. The effect of mission time and energy requirements on these modules is presented to show the effect of mission duration, stay time, crew size, and propellant combination on the size of the complete spacecraft system. In the present study a separate manned module was used for Earth entry and landing in all mission concepts. Modules for interplanetary flight and Mars landing were analyzed, and parametric data were developed for various crew sizes and mission times. The propulsion modules are considered as functions of the energy requirements, duration of propellant storage, payloads, and choice of propellant combinations. The studies indicate that aerobraking configuration cases is more desirable from the standpoint of spacecraft weights and sizes, Earth entry velocities, and general sensitivities to Earth launch windows. P.V.E.

N64-26985* Northrop Corp., Hawthorne, Calif.

MANEUVERABLE DESCENT SYSTEMS FOR MARS LANDING

R. N. Worth *In* NASA. Marshall Space Flight Center Proc. of the Symp. on Manned Planetary Missions, 1963/1964 Status 12 Jun. 1964 p 245–267 (See N64-26979 19-29)
(Contract NAS2-1411) OTS: $31.00 ph

The possibility of using a rocket propulsion system to augment the inherent horizontal translational capability of a gliding parachute system is being studied. The main conclusions derived from the study so far are as follows: (1) Utilization of parachutes as the primary descent system is feasible even for the minimum models of the Martian atmosphere. (2) Augmentation of the gliding capability of the parachute system can be accomplished by application of thrust of proper magnitude and direction. (3) Examination of the optimum systems for the various propulsive requirements that exist during the landing operation indicates that separate propulsion systems will be most efficient. (4) Pilot control of the thrust-augmented gliding parachute landing system is feasible. P.V.E.

N64-26986* General Dynamics/Fort Worth, Tex.

A STUDY OF MANNED MARS EXPLORATION IN THE UNFAVORABLE TIME PERIOD (1975–1985)

R. N. Austin *In* NASA. Marshall Space Flight Center Proc. of the Symp. on Manned Planetary Missions, 1963/1964 Status 12 Jun. 1964 p 279–345 refs (See N64-26979 19-29)
(Contract NAS8-11004) OTS: $31.00 ph

A summary of a study on manned Mars exploration in the unfavorable time period (1975 to 1985) is presented. The basic objectives of the study were the survey and definition of mission profiles for missions during the 1975 to 1985 time period and the recommendation of attractive mission concepts based on selected profiles. The study was divided into two parts. The first part, involving mission and vehicle studies, was concerned with mission trajectory computations; payloads' requirements analysis; systems trade-off analysis; conceptual and preliminary vehicle design studies; atmospheric braking at Mars; and mission–vehicle performance analysis. The second part involved operations-research studies and was concerned with systems cost analysis and development, effectiveness and sensitivity analysis, analysis of technological risk, and concept selection and recommendations. P.V.E.

N64-26987* Douglas Aircraft Co., Inc., Santa Monica, Calif.

MANNED MARS EXPLORATION IN THE UNFAVORABLE (1975–1985) TIME PERIOD

R. L. Gervais *In* NASA. Marshall Space Flight Center Proc. of the Symp. on Manned Planetary Missions, 1963/1964 Status 12 Jun. 1964 p 347–403 (See N64-26979 19-29)
(Contract NAS8-11005) OTS: $31.00 ph

A summary of a study of manned Mars explorations in the unfavorable (1975 to 1985) time period is presented. The

study had four main objectives: (1) to survey all attractive mission profiles for manned Mars missions during the 1975 to 1985 period, and select mission profiles of interest; (2) to define problem areas that appear capable of solution and that, if solved, can markedly improve mission capability during the 1975 to 1985 time period; (3) to develop a multimission vehicle in which all subsystems are compatible with mission profiles and mission requirements in several synodic periods; (4) to determine the nuclear thrust level that should be developed from the interplanetary system-requirements standpoint. P.V.E.

N64-26991 Martin Co., Denver, Colo. Electronics Research Dept.
A PLANETARY TRANSPORTATION MODEL AND ITS APPLICATION TO SPACE PROGRAM PLANNING
G. W. Morgenthaler *In NASA.* Marshall Space Flight Center Proc. of the Symp. on Manned Planetary Missions, 1963/1964 Status 12 Jun. 1964 p 557–609 (See N64-26979 19-29)
OTS: $31.00 ph
(Contract NAS8-11057)

The development of a computerized model that accepts as inputs various complete space programs, including alternative spacecraft, alternative boosters, and alternative exploration missions, is described. The model is being developed to perform quantitative evaluations to assist planners in arriving at valid overall plans. Included are discussions on the need for a planetary transportation model and its objectives, basic logic and progress to date of the planetary model, implementation of the planetary model, and value analysis and future model research areas. P.V.E.

N64-26992* General Dynamics/Astronautics, San Diego, Calif.
A STUDY OF THE DEVELOPMENT OF A BASIC PLANETARY TRANSPORTATION SYSTEMS MODEL
K. A. Ehricke *In* NASA. Marshall Space Flight Center Proc. of the Symp. on Manned Planetary Missions, 1963/1964 Status 12 Jun. 1964 p 611–685 (See N64-26979 19-29)
(Contract NAS8-11084) OTS: $31.00 ph

The Basic Planetary Transportation System Model (BPTSM) study has the following prime objectives: (1) development of a basic methodology of model formulation and (2) development of a computer program that will represent a reasonably comprehensive planetary transportation system model for the 1975 to 1995 time period. The general concept, engineering and management models, and principal input–output areas (submodels) are discussed. Also discussed are the input parameters of the model—extraterrestrial activity specifications; various mission profiles; mission objectives and payloads; propulsion systems; vehicle classes; resources; vehicle-mission integration; vehicle-payload integration; and technological and resources program synthesis. P.V.E.

N64-27137* National Aeronautics and Space Administration, Washington, D.C.
FRENCH NATIONAL REPORT
Jul. 1964 39 p Transl. into ENGLISH of Rapport National de la France, 7th Gen. Assembly of COSPAR, Intern. Council of Sci. Unions, Florence, 8–20 May 1964
(NASA-TT-F-9023)

This is a review of French efforts during 1963 in the fields of astronomy, ionospheric physics, cosmic physics, balloon experiments, rocket experiments, and satellites. G.D.B.

N64-27146* Consultants and Designers, Inc., Arlington, Va.
THE COSMIC DUST ON EARTH [KOSMICHESKAYA PYL' NA ZEMLE]
B. I. Vronskiy and K. P. Florenskiy 19 May 1964 19 p refs Transl. into ENGLISH from Priroda (Moscow), No. 3, 1964 p 90–97 Previously Published as N64-23516 16-12
(Contract NAS5-2078)
(NASA-TT-F-8698; ST-ID-10138)

Earth's accretion of interplanetary matter varies from protons and nuclei of elements that are part of cosmic rays to large meteorites and comets. During the existence of the earth, not only the number of falling particles but also their composition has varied significantly. This article discusses the element interchange processes, investigations of the character and distributions of extraterrestrial matter in upper-atmosphere layers, the genesis of meteoritic balls, and the Tungusska fall. A comparison of computed data from past studies on the amount of cosmic dust falling annually demonstrates the large discrepancies and the need for further research. D.S.G.

N64-27205 Observatorium Bosscha, Bandung (Indonesia)
INTERCONTINENTAL MISSILES [PENTJEGATAN PELURU ANTAR BENUA]
Kusumanto Purbosiswojo 1964 15 p refs *Its* Publ. No. 2 in INDONESIAN; ENGLISH Summary

Some methods of finding preliminary orbital elements of either artificial satellites or ICBM's are discussed. Trivial examples are given that can easily be applied on modern instruments. Author

N64-27226 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
OPERATIONS RESEARCH IN THE ANALYSIS OF SPACE MISSIONS
1 Apr. 1963 21 p
(SM-43611)

Simulation and modeling provide the most powerful tools for use in the analysis of space missions. The results obtained from simulation, however, are irrevocably limited in their validity to the validity of the mathematical system and the value of the coefficients employed. Supporting the simulation capability, therefore, is the requirement to represent technical factors in terms of the gross physical laws involved, specifically avoiding details, and to correlate the observed with the theoretical in recognized statistical language. Discussed in this manual are preliminary efforts in the following specific areas: (1) simulation and modeling; (2) statistical performance of space vehicles; (3) fuel fraction trend for large liquid tanks; and (4) launch weight of vehicles for Mars mission (as a result of optimizing travel time for manned flights). Author

N64-27281* Aeronutronic, Newport Beach, Calif.
AN INVESTIGATION FOR THE IMPLEMENTATION OF ADAPTIVE GUIDANCE Final Report, 23 Mar. 1963–23 Mar. 1964
R. R. Avelmann, D. P. Johnson, and L. W. Stumpf 23 Apr. 1964 69 p refs
(Contract NAS8-5248)
(NASA-CR-58205; U-2659) OTS: $6.60

This report summarizes investigations that considered the trajectories resulting from the application of a small thrust to an object in an inverse square central force field. Analytical solutions for the special cases involving radial, normal, circumferential, and tangential thrusting are reviewed

and extended. A second-order perturbation theory is derived for a vehicle departing from a circular orbit. The trajectory is produced by a thrust vector maintained at a constant, but arbitrarily chosen, angle with respect to the radius vector. Numerical results of the second-order theory are presented that show representative low-thrust trajectories. The perturbation theory is extended to accept elliptical orbit starting conditions. Author

N64-27285* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STUDIES IN THE FIELDS OF SPACE FLIGHT AND GUIDANCE THEORY Progress Report No. 4, Dec. 20, 1962–Jul. 18, 1963
Hans K. Hinz et al 19 Sep. 1963 337 p refs
(NASA-TM-X-51828; MTP-Aero-63-65) OTS: $19.75 ph

This paper contains progress reports of NASA-sponsored studies in the areas of space flight and guidance theory. The studies are carried on by several universities and industrial companies. Author

N64-27301* Massachusetts Inst. of Tech., Cambridge Experimental Astronomy Lab.
GUIDANCE OF LOW-THRUST INTERPLANETARY VEHICLES
Edgar Dean Mitchell (Ph.D. Thesis) Jun. 1964 218 p refs
(Grant NsG-254-62)
(NASA-CR-56188) OTS: $14.50 ph

The problem studied in this thesis is the guidance of interplanetary vehicles that are thrusting for a large portion of the transfer. The vehicle is represented by a seven component state vector consisting of the position, velocity, and mass of the spacecraft. The analysis is linearized by assuming that the actual state of the vehicle differs only a small amount from a known reference state. The reference trajectory is assumed to be a propellant-optimal path connecting the initial and final points. Author

N64-27304* Nuclide Corp., State College, Pa. Nuclide Analysis Associates
ANALYSIS OF THE LUNAR SURFACE AND ATMOSPHERE BY MASS SPECTROSCOPY Summary Report
B. R. F. Kendall, L. F. Herzog, P. J. Wyllie, D. S. Edmonds, and C. Bauer 11 Jan. 1964 168 p refs
(Contract NAS8-11119)
(NASA-CR-56552) OTS: $12.00 ph

A study has been made of problems associated with the determination of the composition of the lunar atmosphere and lunar crust by mass spectroscopy. Methods for determining the mineralogy and petrology of lunar samples from their chemical compositions are summarized. Consideration is given to the characteristics of the lunar environment and its influence on the general design of the lunar instrumentation package. Various types of ion sources, ion mass–charge analyzers, and ion detectors are evaluated. Instrument calibration and ground-based data processing are also discussed. The conclusion of the study is that the most promising type of equipment for the proposed application appears to be a Monopole mass analyzer with an electron bombardment ion source and electron multiplier detector. Author

N64-27358* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN INTERPRETATION OF SCHROTERS VALLEY AND OTHER LUNAR SINUOUS RILLS
Winifred Sawtell Cameron Repr. from J. Geophys. Res., v. 69, No. 12, 15 Jun. 1964 p 2423–2430 refs
(NASA-RP-284)

Several theories have been proposed for the origin of lunar sinuous rills, such as Schröter's Valley. This paper presents a new explanation of the formation of these rills, namely, that they are valleys eroded by nuées ardentes. Characteristics of the rills, including form and association, are cited in support of this theory. Supporting evidence is found in the similarity of the rills to furrows eroded by nuées ardentes on the earth. Author

N64-27451* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EARTH-MARS TRAJECTORIES, 1964. VOLUME 1, PART A
V. C. Clarke, Jr., R. Y. Roth, W. E. Bollman, T. W. Hamilton, and C. G. Pfeiffer 1 Mar. 1964 902 p refs
(Contract NAS7-100)
(NASA-CR-56975; JPL-TM-33-100) OTS: $36.00 ph

This report presents the results of extensive machine computations of three-dimensional ballistic interplanetary trajectories. The analytic model used to represent these trajectories is based upon two-body, inverse-square, force field mechanics; a brief explanation of the model is presented. Basically, the trajectories were calculated in two distinct parts—the heliocentric transfer ellipse and the launch-planet-centered escape trajectories. Following these trajectories, differential corrections or error coefficients and guidance and tracking parameters are given. G.D.B.

N64-27452* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
EARTH-MARS TRAJECTORIES, 1964
V. C. Clark, Jr., R. Y. Roth, W. E. Bollman, T. W. Hamilton, and C. G. Pfeiffer 15 Mar. 1964 834 p refs (For Abstract see N64-27451 19-29)
(Contract NAS7-100)
(NASA-CR-56976; JPL-TM-33-100, Vol. 1, Part B) OTS: $33.50 ph

N64-27651* Lockheed Missiles and Space Co., Palo Alto, Calif.
APPLICATION OF THE CONTINUOUS AND DISCRETE STRATEGIES OF THE MINIMUM EFFORT THEORY TO INTERPLANETARY GUIDANCE
J. V. Breakwell, F. Tung, and R. R. Smith N.Y., AIAA [1964] 12 p refs Presented at the AIAA/Ion Astrodyn. Guidance and Control Conf., Los Angeles, 24–26 Aug. 1964
(Contract NAS1-3777)
(AIAA-Paper-64-664) AIAA: $0.50 members, $1.00 nonmembers

The minimum effort theory is concerned with guiding a vehicle to a specified rms terminal accuracy in the presence of random injection and measurement errors with a minimum expected amount of total velocity correction. It is directly applicable to the case of variable time of arrival terminal control, assuming that the errors are confined to the transfer plane and that the correction mechanization errors are negligible. The purpose of this paper is to apply this theory to the study of guidance problems in typical interplanetary trips. A computer program is developed that performs a linear error analysis of typical interplanetary trajectories with assumed rms injection errors and measurement histories, and that computes a trajectory correction strategy using impulsive corrections whose

magnitude and spacings are chosen to approximate the ideal continuous strategy. The analysis of these near optimum discrete strategies extends the study by a Monte Carlo simulation to include the effect of correction mechanization errors, as well as the effect of varying the time of the last correction. Author

N64-27663* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SIMPLE MODEL OF THE INTERPLANETARY MAGNETIC FIELD, PART I: CALCULATION OF THE MAGNETIC FIELD
David Stern Washington, NASA, Aug. 1964 25 p refs
(NASA-TN-D-2403) OTS: $0.75

A simple model of the interplanetary magnetic field is described and solved analytically. In this model, space is divided into three regions by two concentric spheres. Conductivities (with one exception) are assumed to be isotropic and constant in each region, and flow velocities are regular and prescribed. The innermost region rotates rigidly around its center, the intermediate region contains a compressible fluid flowing radially outward at a constant velocity (an idealization of the solar wind), and the outer region is at rest. The magnetic field originates at point sources at the origin and possibly in a uniform field at infinity. With these assumptions, methods are described for finding the field in the general case, and also in the limit when all conductivities are very high. As example, the case in which the field's source is a point dipole aligned with the axis of rotation is solved in some detail. Author

N64-27666* National Aeronautics and Space Administration, Washington, D.C.
RANGER VII PRELIMINARY RESULTS CONFERENCE, JET PROPULSION LABORATORY, PASADENA, CALIFORNIA
Homer E. Newell et al 31 Jul. 1964 26 p Available from th. Scientific and Technical Information Division

First reports of lunar pictures taken by Ranger VII are presented and evaluated. The quality of the pictures was considered excellent. The most significant result was stated to be the confirmation afforded by the pictures of previously held scientific theories of the moon's composition. It was also held significant that the dimensions of the region of the moon observed were down a factor of a thousand below what had been observable before, and that this tremendous range of new knowledge presented no totally unforeseen problems. Even though the craters increased in number very rapidly, there came a time that the pictures no longer looked as rough as they had at intermediate scales; they began to get smoother, and this was termed significant although it was considered too early to fully interpret this significance. A.W.

N64-27672* General Electric Co., King of Prussia, Pa. Spacecraft Dept.
GUIDANCE REQUIREMENTS FOR AN UNMANNED PLANET LANDING
F. B. Woestemeyer N.Y., AIAA [1964] 12 p Presented at the AIAA/Ion Astrodyn. Guidance and Control Conf., Los Angeles, 24–26 Aug. 1964
(Contract NASw-696)
(AIAA-Paper-64-645) AIAA: $0.50 members, $1.00 nonmembers

The guidance problem is discussed that is associated with the separation of landers from a vehicle on a flyby trajectory, so as to land at specified locations on Mars. The geometry of the problem is presented, including the effects of landing site location and the restrictions in allowable entry angle and propulsive energy. Surface dispersion footprints are presented, based on error analysis. Beginning with a stated navigation uncertainty at the time of lander separation, the effect of errors in imparted velocity increment is evaluated for landing sites in and out of the plane of the approach trajectory. The Schillings atmosphere is used as a basis for computation; the differences that would result with an 11-millibar atmosphere are indicated. The effect of errors from the true atmosphere is evaluated, both as to surface dispersion and the time interval during which line-of-sight contact with the flyby bus can be maintained after touchdown of the landers. Down-range errors are found to be greater than cross range; both are insensitive to range at separation. Under favorable conditions, dispersion of ±100 nmi is found to be possible. Author

N64-27673* General Electric Co., Philadelphia, Pa.
SOLAR PROBE ORBIT DESIGN
B. A. Galman, M. M. Levinson, and J. J. Weinstein N. Y., AIAA [1964] 26 p refs Presented at the AIAA/Ion Astrodynamics Guidance and Control Conf., Los Angeles, 24–26 Aug. 1964
(Contract NAS2-1399A)
(AIAA Paper-64-646) AIAA: $0.50 members; $1.00 nonmembers

Orbit selection studies reflecting consideration of scientific objectives and launch vehicle capabilities have been conducted for a solar probe spacecraft. It is concluded that a number of useful missions can be projected for Atlas-based launch vehicles. In addition to ecliptic orbits having perihelion of 0.29 to 0.35 au, orbits inclined up to 19° to the solar equatorial plane (12° to the ecliptic) can be obtained without undue perihelion growth, a solar radiation monitor can be placed on station for several months, and outward bound orbits to the asteroid belt or perhaps as far as Jupiter appear possible. Future Saturn vehicles will provide even more useful capability, with perihelion performance within 0.1 au and achieving three sun passages within approximately a year (vs two for smaller launch vehicles). Author

N64-27766 Weather Bureau, Washington, D.C.
LOWLIGHT COVERAGE FROM POLAR AND SUN-SYNCHRONOUS ORBITS
Robert L. Pyle Apr. 1964 25 p
(MSL Rept.-30; AD-600970)

Satellites in polar (inclination 90°) and sun-synchronous orbits unavoidably view regions of low illumination during a portion of each orbital pass. The fraction of the pass spent in lowlight areas changes little from day to day but may vary appreciably through the seasons. Analyzed are the seasonal variations in lowlight coverage, as well as in daylight and night coverage, provided by polar and sun-synchronous orbits with various orientations. Author

N64-27803* Rocketdyne, Canoga Park, Calif. Advanced Systems Section
PROPULSION REQUIREMENTS FOR SOFT LANDING IN EXTRATERRESTRIAL ENVIRONMENTS, VOLUME 2 A Final Report
M. S. Bensky Feb. 1963 257 p refs
(Contract NAS7-124)
(NASA-CR-58034; R-5061, Vol. IIA) OTS: $16.50 ph

Propulsion requirements for a soft landing are discussed in terms of landing mission concepts, Earth return missions, Earth–Mars missions, and Earth–Venus missions. G.D.B.

N64-27808* National Aeronautics and Space Administration, Washington, D.C.

THE RELATIONSHIP BETWEEN THE PERIOD OF ROTATION 1958 δ 1 AND SOLAR ACTIVITY [O SVYAZI PERIODA VRASHCHENIYA SPUTNIKA 1958 δ 1 S SOLNECHNOY AKTIVNOST'YU]

V. M. Grigorevskiy Aug. 1964 12 p refs Transl. into ENGLISH from Iskusstv. Sputniki Zemli (Moscow), no. 17, 1963 p 82–90

(NASA-TT-F-8530) OTS: $1.60 ph

The period of rotation of 1959 δ 1, the third Soviet artificial earth satellite, was computed in the following manner. All times M were noted when the observer recorded a brightness maximum, and the following relation was written: $M = M_0 + P'E$, where M_0 is the initial time, P' is the time interval between adjacent brightness maxima, corresponding to P—half the synodical period of rotation of the satellite relative to the transverse axis—and E corresponds to the observed M sequence numbers (epochs). The approximate initial value usually used for M_0 was the time of the first observed brightness maximum, and for P'—the value 10^{-4} day (8.64 sec). Then conditional equations of the following form $\Delta = O - C = \Delta M_0 + \Delta P'E$ were written for determining the differential correction to the assumed approximate value P'. The problem was solved by the "means" method and reduced to the solution of the system of equations

$$\sum_{k=n+1}^{N} \Delta_k = (N - n)\,\Delta M_0 + \Delta P' \sum_{E=n+1}^{N} E.$$

$$\sum_{k=1}^{n} \Delta_k = n\Delta M_0 + \Delta P' \sum_{E=1}^{n} E.$$

where N is the number of successively observed (without a gap) maxima of brightness, $n = 1/2N \pm 1/2$ when N is odd and $n = 1/2N$ when N is even. Subsequent calculations showed that the difference between the synodic and sidereal periods of the satellite was small. I.v.L.

N64-27812* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena

EARTH-MOON TRAJECTORIES, 1964–1969

R. J. Richard, V. C. Clarke, Jr., R. Y. Roth, and W. E. Kirhofer 1 May 1964 562 p refs

(Contract NAS7-100)

(NASA-CR-58223; JPL-TR-32-503) OTS: $26.00 ph

This report gives key characteristics of earth-to-moon trajectories for the period 1964–1969. It is intended to provide trajectory analysts with data, in volume, so that they may perform preliminary design studies and conduct investigations of the properties of ballistic lunar trajectories. Although not exact, these trajectories are sufficiently accurate to be quite useful for this purpose. The data presented assumed launch to occur at Cape Kennedy, arrival to occur when the moon is over the meridian of the DSIF tracking station at Goldstone, California, and the flight time to be between 2 and 3 days. An explanation of the analytical model used in the generation of the data, including detailed equations, is presented. Author

N64-27813* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

GEGENSCHEIN ORBITAL PARAMETERS AND OPERATIONAL SCHEDULE

Stephen J. Paddack Jun. 1964 67 p refs

(NASA-TM-X-55032; X-643-64-133) OTS: $6.60 ph

A technique for defining the location of the Eccentric Orbiting Geophysical Observatory (EGO), S-49, in the gegenschein reference frame is presented. The gegenschein reference frame is an orthogonal coordinate system with its origin at the center of the earth and its fundamental plane lying in the ecliptic plane with one of the axes in this plane pointing directly away from the sun. An operational schedule for the gegenschein experiment is predicted. Since the experiment device cannot tolerate direct or reflected sunlight, the gegenschein experiment package is placed on the dark side of the solar array. The position of the satellite in the gegenschein coordinate system is a function of the orbit and position of the sun. The field of view problem is a function of the location of the satellite, earth and moon, and solar array position, the latter because the gegenschein experiment package rotates with the solar array. As a result of the application of these techniques in computer programs, the position in the gegenschein coordinate system versus time of the EGO is derived, and an operational schedule as a function of solar array angle is presented. Author

N64-27816* National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.

STUDIES IN THE FIELDS OF SPACE FLIGHT AND GUIDANCE THEORY Progress Report No. 2, Dec. 1, 1961–Jun. 15, 1962

26 Jun. 1962 285 p refs

(NASA-TM-X-51827; MTP-AERO-62-52) OTS: $18.00 ph

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7. NUMERICAL APPROXIMATION OF MULTIVARIATE FUNCTIONS APPLIED TO THE ADAPTIVE GUIDANCE MODE R. J. Vance (Chrysler Corp.) p 225–249 refs

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11. ANALYTIC DIFFERENTIATION BY COMPUTER APPLIED TO THE "FLAT EARTH" PROBLEM James W. Hanson (North Carolina U.) p 273–276 refs

N64-27831* High Altitude Observatory, Boulder, Colo.
CLOSE IN SOLAR PROBE Preliminary Draft Report of Suggested Experiments
R. Grant Athay and Lewis L. House 15 Jul. 1963 51 p refs (Supported by NASA)
(NASA-TM-X-51877) OTS: $5.60 ph

The nature of the discussions in this paper is summarized by the following questions: (1) What experiments would be useful to carry out from a space vehicle approaching the sun from the earth? (2) What is the specific scientific purpose of these experiments? (3) At what maximum distance from the sun do these experiments offer enough improvement over similar experiments carried aboard orbiting earth satellites to justify the added technical difficulties of approaching near the sun? (4) What are the general requirements of the spacecraft for pointing accuracy and control? G.D.B.

N64-27838 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
INTERSTELLAR FLIGHTS
K. P. Stanyukovich and V. A. Bronshten 28 Apr. 1964 29 p Transl. into ENGLISH from Kosmos (USSR), No. 1, 1963 p 3-24
(FTD-TT-63-1132/1+2+4; AD-600893) OTS: $0.75

The possibility of interstellar flight at velocities approaching the speed of light, using photon rockets, is discussed. The dimensions of space and the distances to the nearest stars are established as a foundation for a discussion of time and the theory of relativity. The time paradox, whereby interstellar travelers will be relatively younger upon their return to earth than stationary terrestrial inhabitants, is discussed, as well as the influence of gravitational and magnetic fields on the passage of time and on the accelerations of a moving system. Calculations are presented showing that, based on the mechanics of photon rocket flight, a flight to the Andromeda Nebula would take 27.2 proper years or 1.5 million terrestrial years; thus, flight to another galaxy and back is theoretically possible. M.P.G.

30 SPACE VEHICLES

Includes launch vehicle-spacecraft combinations; missile systems; operating problems; safety devices; and stability and control. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-27283* Chrysler Corp., Huntsville, Ala. Space Div.
SATURN S-1 STAGE Final Static Test Report
J. K. Crawford 4 Jun. 1964 169 p
(Contract NAS8-4016)
(NASA-CR-56837) OTS: $12.00 ph

The static acceptance test firings of the saturn flight stage S-1-9 are described. All test requirements were satisfactorily achieved as specified. The performance of all booster systems was satisfactory and acceptable for flight. M.P.G.

N64-27758* Oklahoma State U., Stillwater
SPACECRAFT TEMPERATURE CONTROL BY THERMOSTATIC FINS-ANALYSIS
J. A. Wiebelt and J. F. Parmer Washington, NASA, Aug. 1964 25 p refs
(Grant NsG-454)
(NASA-CR-91) OTS: $0.75

A spacecraft temperature-control system is proposed that consists of thermostatic fins, mounted in pairs. The operation of these fins in conjunction with a white base material is analyzed to determine the surface average temperature with various energy fluxes leaving the surface. As a result of the analysis work in this report, it is proposed that a spacecraft surface system may be designed for given conditions such that the surface temperatures will remain within acceptable limits for electronic apparatus. Author

31 SPACE VEHICLES (LAUNCH VEHICLES)

Includes boosters; clustered rockets; and multistage rockets. *For propulsion engines see*: 27 Propulsion. *For manned space capsules, satellites, and sounding rockets and space probes see*: 32 Space Vehicles (Spacecraft). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-27653 General Dynamics/Astronautics, San Diego, Calif.
STRUCTURAL DESCRIPTION—SLV-3
G. L. Crowell 24 Mar. 1964 69 p refs
(Contract AF 04(694)-240)
(GDA63-0187; AD-440988)

Divided into five sections, this manual contains blueprints and graphic illustrations of the SLV-3, its booster-stage airframe, second-stage airframe, propulsion system, and equipment pods and canisters. A.W.

32 SPACE VEHICLES (SPACECRAFT)

Includes manned space capsules; satellites; and sounding rockets and space probes. *For boosters and launch vehicles see*: 31 Space Vehicles (Launch Vehicles). *For launch vehicle-spacecraft combinations see*: 30 Space Vehicles. *For related information see*: 04 Aircraft; 08 Communications; and 22 Navigation and Guidance.

N64-26988* North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
SUBSYSTEMS REQUIREMENTS FOR A MARS MISSION MODULE
A. L. Jones *In* NASA. Marshall Space Flight Center Proc. of the Symp. on Manned Planetary Missions, 1963/1964 Status 12 Jun. 1964 p 405-440 (See N64-26979 19-29)
(Contract NAS9-1748) OTS: $31.00 ph

A study to develop design criteria for the subsystems required for mission modules for use in interplanetary missions is discussed. The Mars mission concept, used as a guideline for the study, was based on aerodynamic braking at Mars to establish an orbit, with separate modules for landing on Mars and Earth. A basic mission was selected to develop subsystem requirements and to investigate aerodynamic braking. The study indicated that there exists a fine interaction between the crew size and skills, the subsystems, and the ability to perform maintenance. In summarizing the study, it is concluded that aerodynamic braking at Mars in order establish an orbit is a feasible operation considering the expected knowledge of the atmosphere in the time period (1975) of the mission. A workable spacecraft concept was established for performing this maneuver, which included the integration of specific special-purpose modules for excursion to Mars' surface and atmospheric entry upon return to Earth. P.V.E.

N64-26989* Philco Corp., Philadelphia, Pa.
STUDY OF A MANNED MARS EXCURSION MODULE
F. P. Dixon *In* NASA. Marshall Space Flight Center Proc. of the Symp. on Manned Planetary Missions, 1963/1964 Status 12 Jun. 1964 p 441–523 (See N64-26979 19-29)
(Contract NAS9-1608) OTS: $31.00 ph

Preliminary design of a feasible Mars Excursion Module (MEM) for the manned Mars landing mission in the 1970 to 1975 time period is discussed. In general, it is concluded that a MEM with L/D of 1.0 offers sufficient flexibility to perform the assigned mission with high probability of successful return of the crew, samples, and experimental data to justify the expedition. A crew of three would be required. Altitude-compensating-engine development is required. Planetary probes by unmanned spacecraft, orbital rendezvous capabilities development, system developments for the Apollo mission, efficient interplanetary rocket engines, and verification of man's space-operation capability are essential. P.V.E.

N64-26990* Lockheed Missiles and Space Co., Sunnyvale, Calif.
PRELIMINARY DESIGN OF A MARS-MISSION EARTH REENTRY MODULE
D. J. Shapland *In* NASA. Marshall Space Flight Center Proc. of the Symp. on Manned Planetary Missions, 1963/1964 Status 12 Jun. 1964 p 525–576 refs (See N64-26979 19-29)
(Contract NAS9-1702) OTS: $31.00 ph

Preliminary design of an Earth reentry vehicle for use at the termination of a manned Mars mission departing Earth in the years 1971, 1973, and 1975 is discussed. Vehicle selection and performance, reentry heating and thermal protection, structural analysis, subsystem design, and module-design integration are discussed in detail. The study has shown that reentry from a Mars mission at speeds up to 65,000 fps is feasible and that the main limitation is imposed by approach-guidance requirements. The design vehicle used in the detailed study had the following basic characteristics: L/D = 0.6, W/C_DA = 204 lb/ft^2, and half-cone angle of 35° P.V.E.

N64-27069* National Aeronautics and Space Administration, Washington, D.C.
EXPLORER XIX, THE AIR DENSITY SATELLITE NASA Facts, Vol. II-2
[1964] 6 p

Explorer XIX is essentially a 12-ft-diameter inflated sphere weighing about 17 lb. It is constructed of a 4-ply laminate, consisting of alternating layers of 1/2-mil-thick polyester plastic film and 1/2-mil-thick aluminum foil. The principle purpose of the Explorer XIX experiment is to extend measurements of air density in the upper atmosphere to the polar regions. Scientists calculate the air density in the satellite's path by comparing the spacecraft's orbit with a theoretical orbit based upon the absence of air. Another experimental goal is to learn more about the contributions of energetic particles and ultraviolet light to heating and, consequently, to density of the upper atmosphere. Explorer XIX was orbited by a Scout launch vehicle on December 19, 1963. At launch, the satellite was folded and packed inside a metal cylinder. In orbit, compressed nitrogen gas pushed the sphere from its container and inflated it to a 12-ft diameter. Initially, the satellite's apogee was almost 1,490 miles; its perigee, about 368 miles; and its period, approximately 116 minutes. Its orbit swings out as far north as Thule, Greenland, and as far south as the Antarctic continent. I.v.L.

N64-27204* National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio
MICROMETEOROID SATELLITE (EXPLORER XVI) STAINLESS-STEEL PENETRATION RATE EXPERIMENT
Elmer H. Davison and Paul C. Winslow, Jr. Washington, NASA, Aug. 1964 17 p refs
(NASA-TN-D-2445) OTS: $0.50

A successful experiment to assess the meteoroid hazard to thin stainless-steel skin material was flown as part of the Explorer XVI satellite. A total initial area of 3.625 sq ft consisting of 0.001-, 0.003-, and 0.006-in.-thick AISI 304 stainless-steel segments was exposed in space for a period of 221 days. The 0.001-in.-thick surface experienced six penetrations, the 0.003-in.-thick surface experienced one penetration, and the 0.006-in.-thick surface experienced zero penetrations. This report describes the results of the experiment and the conclusions drawn from the results. Author

N64-27251* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SHADES OF EGO, S-49
H. E. Montgomery, S. J. Paddack, and F. B. Shaffer Jan. 1964 103 p refs
(Contract NAS5-2535)
(NASA-TM-X-55014; X-640-64-19) OTS: $9.10 ph

This report presents shadow data and heat input data for the S-49 EGO. It gives times for which each experiment is in the shadow of either the earth, the satellite's main box, or the solar array. It also gives the heat inputs to the experiments as a function of time from launch for one complete orbit. The heat inputs include direct solar radiation, reflected solar radiation, and earth-emitted radiation. Author

N64-27260* National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
VARIATIONS IN THE ECCENTRICITY OF THE SATELLITE 1962 $\beta\ \alpha$
T. L. Felsentreger and J. P. Murphy Jun. 1964 14 p refs
(NASA-TM-X-55053; X-547-64-146) OTS: $1.60 ph

A study of the satellite 1962$\beta\alpha$ (Alouette) during the period April 27, 1963, to March 8, 1964, revealed a long-period perturbation (approximately 140 days, the period of the argument of perigee) in the eccentricity of its orbit, plus shorter-period variations. An analysis of the possible sources of these perturbations was undertaken, neglecting air drag, since perigee was about 1,000 km. Mean orbital elements for this period, computed using Brouwer's satellite theory, were obtained from

the Goddard computing center. These elements take into account the effects due to zonal harmonics (through J_5) in the earth's gravitational potential. Author

N64-27404* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TIROS IV RADIATION DATA CATALOG AND USERS' MANUAL
Virgil G. Kunde, ed. 15 Dec. 1963 259 p refs
(NASA-TM-X-51826) OTS: $16.50 ph

The TIROS IV meteorological satellite contains a medium resolution scanning radiometer. Two of the channels of this instrument are sensitive to reflected solar radiation and the remaining two respond to emitted thermal radiation from the earth and its atmosphere. The two thermal channels are calibrated in terms of equivalent blackbody temperatures, and the reflected solar radiation channels are calibrated in terms of effective radiant emittances. The calibration data, along with orbital and attitude data and the radiation data from the satellite, were incorporated in a computer program for an IBM 7090 that was used to produce, in binary form, the Final Meteorological Radiation Tape, which is the basic repository of all radiation data. After launch, the radiometer displayed the same degradation of response characteristics as did its predecessors in TIROS II and TIROS III. In this catalog–manual, the radiometer and its calibration, data processing, the Final Meteorological Radiation Tape, the observed degradation patterns, and possible corrections for degradation are discussed. Author

N64-27504* National Aeronautics and Space Administration, Washington, D.C.
NIMBUS WEATHER SATELLITE SCHEDULED FOR LAUNCH News Release No. 64–195
9 Aug. 1964 40 p
Available from the Scientific and Technical Information Division

This NASA news release announces the launching of the Nimbus weather satellite in terms of its objectives, the attitude-control subsystem, the power supply, the automatic picture-transmission camera, the high-resolution infrared radiometer, the clock and command subsystem, the spacecraft thermal control, the telemetry subsystem, the Nimbus technical control, the data-acquisition facilities, the data-handling system, and the automatic picture-transmission ground stations. G.D.B.

N64-27524 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
A BRILLIANT NEW VICTORY OF SOVIET COSMONAUTICS: VALERI BILOVSKI AND VALENTINA TERESHKOVA IN A NEW COSMIC TANDEM
Florin Zaganescu 8 May 1964 13 p Transl. into ENGLISH from Stiinta si Tehnica (Bucharest), No. 7, 1963 p 13–15
(FTD-TT-64-34/1+2+3+4; AD-600610)

This is a semitechnical article from a Rumanian magazine on the twin flight of the Vostoks V and VI. Emphasis is placed on the biotelemetry of prolonged space flights. G.D.B.

N64-27560 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME V: FALL 1960 FIRINGS Data Report
Jul. 1964 304 p
(IRIG-109-62; AD-444385)

The Loki II is capable of placing a 2-lb chaff payload to 250,000 ft. Chaff dispersion and fall rate usually prevent chaff tracks below 150,000 ft. The Loki I carries an 8-ft mylar parachute or a fast-fall chaff payload to about 120,000 ft. The Arcas rocket is intended to provide instrumentation for wind and temperature measurements from 200,000 ft to about 50,000 ft. The 15-ft metallized nylon parachute of the Arcas provides a passive wind sensing radar target and carries special temperature measuring instrumentation. Wind data are obtained from radar plotting grids through a graphical conversion of the sensor displacement during a standard time increment into average velocity components. Altitudes are also obtained from the grids and represent the mean altitude for each time interval. The current standard reduction technique utilizes a one-minute time interval. The wind profiles presented are made up by connecting each time interval computation and are not smoothed further. No corrections are applied for sensor fall rates. Temperature instrumentation consists of a modified 1,680-mc radiosonde transmitter unit and a 10-mil bead thermistor sensor. Recording is accomplished with standard Ground Meteorological Detection equipment (GMD). The temperature data are published in raw form, with no correction for fall rate, radiation, conduction or sensing current. Author

N64-27561 Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
METEOROLOGICAL ROCKET NETWORK FIRINGS. VOLUME VI: WINTER 1960–61 FIRINGS Data Report
Jul. 1964 197 p
(IRIG-109-62; AD-444384)

Wind data are obtained from radar plotting grids through a graphical conversion of the sensor displacement during a standard time increment into average velocity components. Altitudes are also obtained from the grids and represent the mean altitude for each time interval. The current standard reduction technique utilizes a variable time interval during the sensor descent as follows: a 1/2-minute interval to X + 5 minutes, a one-minute interval to X + 20 minutes, and a two-minute interval to termination. The variable interval was introduced as a compensation for the fall rate characteristics of the sensor. The wind profiles presented are made up by connecting each time interval computation and are not smoothed further. No corrections are applied for sensor fall rates. Temperature instrumentation consists of modified 1,680 mc radiosonde transmitter units and bead thermistor sensors. Recording is accomplished with standard Ground Meteorological Detection equipment (GMD). Considerable design improvement has been effected in the current rocket temperature instrumentation, and a comparison with standard radiosonde equipment, where available, indicates that the rocket system is quite reliable over the balloon range of altitude. Author

N64-27644* Hughes Aircraft Co., El Segundo, Calif.
DESIGN CONSIDERATIONS FOR THE SURVEYOR TERMINAL DESCENT SYSTEM
R. K. Cheng and D. A. Conrad N.Y., AIAA, [1964] 20 p refs Presented at the AIAA/Ion Astrodyn. Guidance and Control Conf., Los Angeles, 24–26 Aug. 1964 Prepared for JPL
(Contract NAS7-100; JPL-950056)
(AIAA-Paper-64-644) AIAA: $0.50 members, $1.00 nonmembers

The Surveyor mission is to soft-land an unmanned vehicle and its payload on the lunar surface. The various payloads, which may vary from one launching to the next, consist of

instrumentation for measuring surface and environmental properties, and television equipment for both the approach and the post-landing survey phases. While landing areas will be predesignated long before launch, position control is employed only during the single midcourse correction to be executed roughly halfway to the moon. The landing requirements emphasize survival during touchdown, with structural integrity and attitude stability as the chief criteria. For the space frame currently under development, the touchdown velocity must be less than 20 fps with a horizontal component of less than 7 fps. Slopes up to 15° or so can be accommodated without toppling if the velocity requirements are satisfied. Author

N64-27667* National Aeronautics and Space Administration, Washington, D.C.
AMERICA IN SPACE A Pictorial Review
[1964] 75 p
(NASA-EP-14-Rev.5-64) GPO: $0.45

This pictorial review was published to commemorate NASA's fifth anniversary. Efforts of the U.S. in outer space are surveyed in photographs and charts to present a brief picture of NASA's space program. The various projects, astronauts, satellites, and support equipment are discussed in a nontechnical fashion. G.D.B.

N64-27757* National Aeronautics and Space Administration, Washington, D.C.
NASA'S SYNCOM C SATELLITE IS SET FOR LAUNCHING News Release No. 64-193
13 Aug. 1964 21 p Available from the Scientific and Technical Information Division

According to NASA, an attempt to achieve the first truly stationary orbit will be made when NASA launches Syncom C, the third synchronous-orbit communications satellite. If successful, Syncom C will appear to remain over one spot on earth rather than moving back and forth over the Equator. The choice of the equatorial orbit, Syncom C improvements, and the TAD (Thrust Augmented Delta) launch vehicle are among the topics discussed. R.T.K.

N64-27767 Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
S-IV/S-IVB AS MANNED SPACE LABORATORY
Feb. 1963 70 p refs Revision of SM-42587
(SM-43257; SM-42587)

This report attempts to answer the following six questions: (1) Why an early space laboratory? (2) When and how can we get an early space laboratory? (3) What would a space laboratory be like? (4) How would a space laboratory be developed? (5) How much would a space laboratory cost? (6) What conclusions can be drawn from the material presented? Four appendixes are included—national space objectives, space-vehicle subsystem phasing, 100-day mission, and live-in-tank summary. G.D.B.

N64-27801* Planning Research Corp., Los Angeles, Calif.
RELIABILITY ASSESSMENT OF THE MARINER SPACECRAFT
James D. Andrew, Eloise E. Bean, William E. Faragher, and Richard G. Salter 17 Dec. 1962 175 p refs Prepared for JPL
(Contract JPL-BU-3-213751)
(NASA-CR-58070; PRC-R-293) OTS: $12.50 ph

The results of a quantitative reliability assessment of the Mariner spacecraft are reported, and conclusions regarding the reliability of the spacecraft subsystems are stated. The reliability figure-of-merit approach is utilized to provide a realistic evaluation of the probabilities of successfully achieving the various mission objectives. In addition, classical reliabilities of events and functions are computed on a parts count basis so that specific areas of the spacecraft can be examined in more detail. Through consideration of the reliability assessment results, the most applicable testing techniques are outlined, and a few areas are identified as the most likely candidates for limited design reevaluation. Complete data on failure-rate estimates and parts counts are included. Author

N64-27821* Lincoln Lab., Mass. Inst. of Tech., Lexington
MARINER A PLASMA PROBE Technical Report No. 337
H. S. Bridge, B. Rossi, F. Scherb, R. H. Baker, R. S. Cuikay et al
5 Dec. 1963 62 p Prepared for JPL
(Contract NAS7-100; JPL-950070)
(NASA-CR-56794) OTS: $6.60 ph

This report describes the purpose and function of plasma instrumentation designed and built for use with Mariner A spacecraft. The equipment determines the particle-number density and energy spectra of plasma protons and electrons, and the direction of motion of the plasma. The basic sensor unit is a faraday cup that measures a current produced by the proton or electron component of the plasma. The electronic circuits that operate the sensors are discussed in detail. The measurement link receives a modulated signal (10^{-12} to 10^{-7} amp at 2kc/s) from the faraday cup collector and amplifies, compresses, and demodulates it to present a d.c. output signal to the spacecraft data automation system. The high-voltage supply contains a modulator that produces a 2-kc/s square wave of variable amplitude (approximately 10 to 3,000 v), which is applied to the faraday cup grids. The sequence of operations in a measurement cycle is controlled by the logic circuit, which is in turn controlled by the spacecraft data automation system. Author

N64-27825* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SPACE OPERATIONS CONTROL CENTER SATELLITE Situation Report, Volume 4, No. 10
31 May 1964 12 p
(NASA-TM-X-51811; X-533-63-1)

This satellite situation report contains the following information on objects in orbit from 1 February 1958 to 31 May 1964: object, code name, catalog number, source, launch, nodal period, inclination, apogee, perigee, transmitting frequency, and date of decay. R.T.K.

N64-27826* Consultants and Designers, Inc., Arlington, Va.
TWO LAUNCHINGS IN SPACE
Feb. 1964 4 p Transl. into ENGLISH of Two TASS Press Releases to Pravda (Moscow), no. 31, 31 Jan. 1964
(Contract NAS5-2078)
(NASA-CR-56644; ST-PR-10109) OTS: $1.10 ph

This is a Tass agency news release announcing the twin launching of Soviet satellites Elektron I and II. The purpose of the satellites is to study the inner and outer radiation belts, together with the attending physical phenomena. G.D.B.

N64-27834* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE SITUATION REPORT, VOLUME 2, NO. 6
Ralph R. Stroble 13 Mar. 1962 4 p
(NASA-TM-X-51780) OTS: $1.10 ph

This satellite situation report contains the following information on objects in orbit from 1 February 1958 to 13 March 1962: object, code name, source, launch, nodal period, inclination, apogee, perigee, transmitting frequency, and date of decay. R.T.K.

N64-27841 Air Force Systems Command, Wright-Patterson AFB, Ohio Foreign Technology Div.
FIVE MILLION KILOMETERS IN SPACE
28 Apr. 1964 22 p Transl. into ENGLISH from Priroda (Moscow), no. 7, 1963 p 11–18
(FTD-TT-64-119/1+2+4; AD-601078) OTS: $2.60

The space flights of Vostok V and Vostok VI are described, and the press conference held on the successful flight of these spacecraft is presented. R.T.K.

N64-27860 State U. of Iowa, Iowa City
SOLAR X-RAY OBSERVATIONS BY INJUN 1
B. Maehlum, L. A. Frank, and J. A. Van Allen Jul. 1964 29 p refs
(Contract Nonr-93803)
(SUI-64-27; AD-603427)

The following were found on the basis of 36 random observations of the sun during July–August 1961 with a thin mica window Geiger tube on satellite Injun I: (1) The quiet-day solar X-ray flux at 1 au in the wave length range $\lambda < 14$ A is about 1×10^{-3} ergs $(cm^2\ sec)^{-1}$. (2) There is clear enhancement of such X-ray flux during visual solar flares by a factor of about 4 during 1 or 1^+ flares and by a factor of about 40 during a 3^+ flare. (3) The time required for the solar X-ray emission to return to quiescent values after a flare of importance 1 is 1 to 2 hours. For more important flares the time is greater. Author

33 STRESSES AND LOADS

Includes fatigue; vibration; flutter; and structural tests. *For thermal stress see*: 13 Heat Transfer and Thermodynamics. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 34 Structural Design.

N64-27048 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
THE OPTICAL DETERMINATION OF INTERNAL STRESSES
Henry Favre 28 May 1964 29 p refs Transl. into ENGLISH from Rev. d'Optique (Paris), v. 11, no. 1, 1932 p 1–21
(RSIC-190; AD-443427)

There are five methods that allow determination of stresses in a transparent two-dimensional model—one optical-mechanical method, two optical-graphic methods, and two purely optical methods. The charactersitics of each method are given in an annotated table. It is stated to be logical to use simultaneously one of the first three methods and one of the last two. Two improved devices for a purely optical method are described, and their accuracy and speed of operation are noted. The extension of these methods to three-dimensional problems is considered, and the major difficulty is seen to be the production of adequate transparent models. D.E.W.

N64-27049 Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
ON THE PROBLEM OF THE SHAPE FACTOR
A. Thum and W. Bautz 13 Jul. 1964 16 p refs Transl. into ENGLISH from Z. Ver. Deutsch. Ing. (Berlin), v. 79, no. 43, 1935 p 1303–1306
(RSIC-213; AD-443430)

Shape factors for tensile, bending, and torsional stress have been compiled for several simple notch shapes, both from the literature and from experiments of the authors. The individual curves are critically inspected with regard to usefulness and reliability, and the designer is supplied with data upon which he can base his calculations. Author

N64-27201* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EXPERIMENTAL AND ANALYTICAL VIBRATION STUDY OF A RING-STIFFENED CYLINDRICAL SHELL STRUCTURE WITH VARIOUS SUPPORT CONDITIONS
John L. Sewall, Robert R. Clary, and Sumner A. Leadbetter Washington, NASA, Aug. 1964 54 p refs
(NASA-TN-D-2398) OTS: $1.50

This paper reports an experimental and analytical vibration study of two ring-stiffened cylindrical shell models used in search of a suitable design for the test chamber of the Langley low-frequency noise facility. One of these models consisted of a steel cylindrical shell with steel rings of I-beam cross section welded to the outside surface and spaced in six nearly equal intervals along the length. The other model was formed from this single-wall model by fastening an outer shell on the outer flanges of the rings. Natural frequencies and mode shapes of both models were measured under various end and longitudinal support conditions. Installation of the outer shell resulted in slight increases in frequency that were not considered sufficient to warrant the use of an outer shell on the full-scale test chamber. Despite the bothersome apparent existence of multiple resonances having the same mode shape, experimental results show that the natural frequencies increase as the degree of end fixity increases, although the frequency increases were not as great as desired because of insufficiencies in the end clamping action in the configurations tested. Author

N64-27224 Lockheed Missiles and Space Co., Sunnyvale, Calif.
BUCKLING OF AXIALLY COMPRESSED SANDWICH CYLINDERS
B. O. Almroth Jul. 1964 32 p refs
(Rept.-6-62-64-9)

In a previous report a practical method of stability analysis was derived for axially compressed orthotropic cylinders. The method was based on upper and lower bounds to the critical load. However, in the analyses of these bounds the effects of transverse shear forces were neglected, and therefore the results were not applicable to cylinders of weak-core sandwich design. The analysis presented here modifies the previous analysis by inclusion of such effects. Numerical results for the two bounds are given in graphical form. Author

N64-27307* Bell Aerosystems Co., Buffalo, N.Y.
STUDY OF ZERO-GRAVITY POSITIVE EXPULSION TECHNIQUES Interim Report No. 8230-933007, 16 Mar. 1963–15 Jan. 1964
Apr. 1964 172 p refs
(Contract NAS7-149)
(NASA CR-56295) OTS: $12.50 ph

This report discusses structural investigation of metallic bellows, dynamics investigation of metallic bellows, permeation technology, and optimum envelope investigation. Modifications incorporated into the structural analysis, started during the basic program, are described. Also presented are results from a preliminary study of the effects of variation in geometric parameters. The dynamics analyses include a comparison of the bellows accordion mode and the general case of a longitudinal homogeneous bar fixed at both ends. A mathematical model for the liquid modes was also developed. This porous bar concept demonstrated good agreement with test data. Results of an experimental test program to determine the dynamic characteristics of double-ply bellows are included. The permeation work is a continuation of the investigations initiated during the original program on detectors. As a result of this work, the thermistor-type detector was selected as the most practical. Both the design and the application of this detector are discussed. A new permeation chamber, using a corrugated diaphragm in place of a bellows, is discussed, and the results of development testing with this apparatus are presented. On bellows assemblies, a series of graphs is presented for use in selecting the lightest weight bellows assembly. Author

N64-27313* Southwest Research Inst., San Antonio, Tex.
A SURVEY OF THE LITERATURE ON THE VIBRATIONS OF THIN SHELLS Technical Report No. 1
William C. L. Hu 30 Jun. 1964 35 p refs
(Contract NASr-94(06))
(NASA-CR-58048) OTS: $3.60 ph

A survey of the literature pertaining to free vibrations of thin elastic shells is presented with particular attention to shells of different geometries. The abundant literature on the vibration of circular cylindrical shells is reviewed only to the extent that it sheds light on the general shell vibration problem. Only limited information concerning other shell configurations exists in the published literature. Of these, the spherical shell and the truncated conical shell have received by far the most attention. Author

N64-27360* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A STUDY OF THE EFFECTIVENESS OF VARIOUS METHODS OF VIBRATION REDUCTION ON SIMPLIFIED SCALE MODELS OF THE NIMBUS SPACECRAFT
Huey D. Carden and Robert W. Herr Washington, NASA, Aug. 1964 26 p refs
(NASA-TN-D-2418) OTS: $0.75

The results of an experimental investigation of the effectiveness of various isolation and damping methods in reducing the dynamic response of simplified scaled models of the Nimbus spacecraft to vibratory inputs are presented. Experimental mode shapes and natural frequencies of the simulated solar panels were determined and found to compare well with calculated values. Appreciable reductions of structural responses to vibratory input motions were measured for independent inputs along the roll, pitch, and yaw axes for the cases in which distributed damping and/or isolation was utilized. A comparison of the response of the model with the full-scale spacecraft for inputs along the pitch axis is presented. Also included are the effects of stiffness between the control and sensory sections on the response of the model to vibratory inputs. Author

N64-27362* National Aeronautics and Space Administration. Marshall Space Flight Center Huntsville, Ala.
OBSERVED TORQUE-PRODUCING FORCES ACTING ON SATELLITES
Robert J. Naumann NASA, Wash. Dec. 1963 32 p refs
(NASA-TR-R-183) OTS: $1.00

In addition to the forces that influence the motion of the center of mass of a satellite, various forces are also present that influence the motion about the center of mass. These torque-producing forces may result in a change in satellite orientation that affects the thermal balance, operation of solar cells, various scientific measurements, and drag forces. This latter effect results in a coupling between the equations describing the orientation with those describing the orbital motion. Therefore, strictly speaking, the orientation problem is part of the orbital problem. To solve the orientation equations it is necessary to determine the nature of the torque-producing forces. This is done by observing the change in orientation of several Explorer satellites where the drag force is sufficiently small so the orbital dependence on orientation is negligible. It was found that permanent magnetic moments in the satellites were the dominant effect responsible for the observed changes in orientation. Gravitational torques are also significant. The changes in orientation of the satellites considered were explained extremely well by these two effects, hence it is concluded that other effects are not significant for similar satellites. Author

N64-27403* Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
AN ENERGY METHOD FOR PREDICTION OF NOISE AND VIBRATION TRANSMISSION
Richard H. Lyon Repr. from Shock, Vibration and Associated Environments, DOD Bul. No. 33, Pt. II, Feb. 1964 p 13-25 refs Previously published as N64-18537 11-33
(Contract NASr-47)

The problem of malfunction in components at high frequencies is reviewed. The overall problem is one of environmental excitation, acoustic and vibration transmission paths, and establishment of criteria for noise reduction through component criteria. The source problem is being studied by several groups. Several aspects of the vibration path problem are described. Experimental studies of transmission effects and establishment of component criteria are hampered by a shortage of instrumentation capable of operating at the higher frequencies. Author

N64-27410 College of Aeronautics, Cranfield (Gt. Brit.)
TABULATION OF SOME LAYOUTS AND VIRTUAL DISPLACEMENT FIELDS IN THE THEORY OF MICHELL OPTIMUM STRUCTURES
H. S. Y. Chan Feb. 1964 17 p refs
(COA-N-AERO-161)

In the theory of two-dimensional Michell optimum structures, there arises the problem of calculating the lines of principal stresses and the virtual displacements that are analogous to slip lines and velocities in plane plastic flow. Two special problems are considered in this paper, in which the strain fields are generated from two given orthogonal curves with negative initial curvatures. A curvilinear system is defined so that the magnitudes of the parameters are chosen as the angles

between the tangents of the curves and two fixed directions, which are cartesian axes with the same origin as the parameters. G.D.B.

N64-27412 Bettis Atomic Power Lab., Pittsburgh, Pa.
A PRESSURE-DEFLECTION RELATION FOR A CLAMPED CIRCULAR PLATE IN THE PLASTIC RANGE
F. V. Naugle, J. E. Mc Cauley, and F. O. Bingman Jul. 1964 23 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-282) OTS: $0.50

An evaluation was completed to determine pressure-deflection characteristics of small diameter clamped plates having radius-to-thickness ratios ranging from 1.5 to 16.0. Based on experimental data, an analytical model was developed that adequately describes plate deflection as a function of applied pressure. The rupture pressure of these clamped plates was estimated from a calculational model. The calculated rupture values were found to be in fair agreement with experimental rupture data. Author

N64-27420 Brown U., Providence, R.I. Engineering Div.
PLASTIC BUCKLING OF AXIALLY COMPRESSED CYLINDRICAL SHELLS
S. C. Batterman Mar. 1964 62 p refs
(Grant NsF-GP-1115; Contract ARPA-SD-86)
(AD-441942)

The plastic buckling of cylindrical shells under axial compression is studied analytically and experimentally. Attention is given to both the nonlinear and the nonconservative aspects of the stress–strain relation. The effect of unloading is investigated in an exact manner for a hinge model that is proposed and in both an exact and an approximate manner for a geometrically perfect shell. Thirty tests are reported on cylindrical shells of 2024-T4 aluminum with radius-to-thickness ratios of 120 through 10 and length-to-radius ratios of 0.20 to 7. Specimens were prepared with three different types of end conditions and were tested either through a ball and socket arrangement or flat ended between smooth bearing blocks. A simple (J_2) incremental theory gives results very close to J_2 deformation theory and predicts both buckling strength and the geometry of buckling for thick and moderately thick shells. Author

N64-27449 David Taylor Model Basin, Washington, D.C. Structural Mechanics Lab.
GRAPHICAL ANALYSIS FOR MAXIMUM STRESSES IN SANDWICH CYLINDERS UNDER EXTERNAL UNIFORM PRESSURE Research and Development Report
James A. Nott May 1964 22 p refs
(DTMB-1817; AD-441779)

A simplified solution is presented for computing the axial and transverse forces in sandwich cylinders with annular webs loaded under external uniform pressure. A series of graphs is shown for the determination of Lamé deflection coefficients and transcendental stress functions. With these forces and stress functions, a procedure is developed for computing maximum stresses in both outside and inside shells of the sandwich cylinders. Stresses can be computed more rapidly by this procedure than by a more exact solution. Author

N64-27466 California Inst. of Tech., Pasadena Firestone Flight Sciences Lab.
SIZE EFFECTS ON FATIGUE CRACK PROPAGATION
H. W. Liu Wright-Patterson AFB, Ohio. Aerospace Research Labs., Apr. 1964 49 p refs
(Contract AF 33(616)-6270)
(ARL-64-68; AD-603406) OTS: $3.00

The expressions for crack propagation rate as proposed by various investigators were closely examined. In particular, the discrepancy between Weibull's constant propagation rate formula and the behavior $dl/dN = Cl$ is reconciled by the overall geometric effect in a finite plate. Furthermore, the strain concentration due to localized necking accounts for the difference from formulas recommended by Paris and Erdogen, and McEvily and Boettner. The experimental results of Frost and Dugdale are also compared with the author's previous results. A physical model for fatigue fracture mode transition based on the thickness effect has been proposed. The calculated points of transition in comparision with the experimental results indicate a consistent pattern as suggested by the proposed model. A concept for nonpropagating crack is suggested. Author

N64-27539 Florida U., Gainesville
RANDOM VIBRATIONS OF NONLINEAR ELASTIC STRUCTURES
Richard E. Herbert May 1964 34 p refs
(Grant AF-AFOSR-62-313)
(AFOSR-64-0887; AD-602488)

The theory of the Markoff process and the associated Fokker–Planck equation are used to investigate the large vibrations of beams and plates with arbitrary boundary conditions subjected to white noise excitation. An expression for the joint probability density function of the first N coefficients of series expansions of the middle surface displacements is obtained. Detailed calculations presented for simply supported beams and plates show that the probability density function of the modal amplitudes are nongaussian and statistically dependent. Numerical computations for the plate indicate a significant reduction of the mean squared displacement for values of the parameters well inside the range of practical considerations. Furthermore, for smaller aspect ratios the percent reduction is greater. Author

N64-27616 Joint Publications Research Service, Washington, D.C.
DETERMINATION OF ICE LOAD ENCOUNTERED BY SHIP PROPELLER BLADES
M. A. Ignatyev 20 Aug. 1964 16 p refs Transl. into ENGLISH from Problemy Arktiki i Antarktiki (Leningrad) no. 15, 1964 p 41–51
(JPRS-26033; TT-64-41303) OTS: $1.00

During motion of a ship in ice conditions propellers are systematically subjected to the effect of short-time dynamic loads occasioned by interaction of propeller blades with ice. Study of the work of the propulsive installation in ice conditions was carried out on various ships having a comparatively large range of applied power, propeller diameter, and displacement. Numerous oscillographic investigations under natural conditions for determination of loads from ice encountered by propellers showed that the greatest moment of resistance during interaction of propeller blades with ice reaches three to four times the nominal moment of the motor during work of the propeller in a moored state. The dynamic loads encountered by propeller blades appear limiting for a given type of ship and can be transposed to propellers falling within their diameters and capacities. Author

N64-27629 Minnesota U., Minneapolis
CHARACTERISTICS OF RAYLEIGH WAVE DISPERSION ON A TWO-LAYERED SOLID HALF-SPACE FOR FUNDAMENTAL, FIRST SHEAR, AND SECOND SHEAR MODES Summary Report, May 1, 1962–Apr. 30, 1964
Harold M. Mooney [1964] 9 p
(Grant AF-AFOSR-62-411; ARPA Order-180-62)
(AD-441647)

The dispersion of Rayleigh waves on a solid layer overlying a solid half-space was investigated theoretically. Solutions are obtained for the fundamental mode and the first two shear modes. All computations were carried out in terms of dimensionless variables. The independent variable B_1T/H (where B is the shear velocity, T is the period, and H is the layer thickness), the phase velocity and the group velocity, and the surface-displacement amplitude ratio were studied. Results were computed for several hundred cases from among the 4,096 possible. These were selected to exhibit the full range of variation of the parameter. The preliminary results are presented. R.T.K.

N64-27686 National Academy of Sciences-National Research Council, Washington, D.C. Materials Advisory Board
DESIGN FOR BRITTLE MATERIALS Report of the Ad Hoc Committee
Carl S. Marvel 20 May 1964 46 p refs
(Contract ARPA-SD-118)
(MAB-198-M; AD-601570) OTS: $1.25

Research and development recommendations on designing for brittle materials are discussed in terms of characterization of the material—the problem of defining the material as the factors determining its behavioral response; analysis—predicting how the designed part will behave when subjected to different sets of conditions in its design application; and the design area—how to best select an appropriate material, and then how to fashion the material into a part to perform a specified function. G.D.B.

N64-27845 Aviation Safety Engineering and Research, Phoenix, Ariz.
STRUCTURAL ANALYSIS OF THREE CRASH IMPACT CONFIGURATIONS IN STEEL TUBE AND FABRIC AIRCRAFT Preliminary Report
James P. Avery and Ruth M. Petry Ft. Eustis, Va., Army Transportation Res. Command, May 1964 43 p
(Contract DA-44-177-AMC-888(T))
(AVSER-63-9; TRECOM-TR-64-5; AD-604026) OTS: $2.00

This report covers the development of limited mathematical models to predict in qualitative terms the capability of a light airframe structure (of the Piper J-3 type) to withstand crash under three impact conditions. Two indices of crash worthiness were selected: (1) the aircraft velocity required to cause structural collapse short of general cabin collapse, and (2) the maximum deceleration applied to the occupants during the crash. Engineering analysis and physical principles are applied to each appropriate mathematical model to develop the crash-worthiness indices. Sample calculations were made for the Piper J-3 in three typical crash impact configurations: nose impact, nose and wing impact, and impact on the landing gear (considering only the vertical velocity component). The preliminary study reveals that the crash-worthiness indices selected are potentially useful in evaluating structural modifications. Author

34 STRUCTURAL DESIGN

Includes structural elements; and weight analysis. *For related information see*: 02 Aerodynamics of Bodies, Combinations, and Internal Flow; 03 Aerodynamics of Wings, Rotors, and Control Surfaces; and 33 Stresses and Loads.

N64-27037 General Electric Co., Philadelphia, Pa. Missile and Space Div.
DETERMINATION OF OPTIMUM DESIGN OF COLUMNS SUBJECTED TO COMBINATIONS OF STEADY STATE AND CYCLIC LOADS
Apr. 1964 15 p refs
(N-20288-T)

There appears to be a strong, practical need for a comprehensive test program that will result in an acceptable method of analysis for strength determination of columns subjected to combinations of cyclic and steady-state longitudinal end loading. A multiphase approach is suggested for this study. Using this approach, the first phase would consider only structure elements classified as long, pin-ended columns fabricated from 2040-T3 Al tubing. This phase would be accomplished by an experimental program encompassing the dynamic–static load frequency ranges prevalent in current aerospace structures, and culminating in a reliable dynamic failure criterion for this one class of column members. At the conclusion of the first-phase effort, additional areas will be recommended for further investigation. I.v.L.

N64-27244* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
BOOSTER PARAMETRIC DESIGN METHOD FOR PERFORMANCE AND TRAJECTORY ANALYSES. PART 1: CONFIGURATION
Vincent Verderaime 18 Mar. 1964 39 p refs
(NASA-TM-X-53026) OTS: $3.60ph

A method is presented for mathematically describing the geometric configuration of a conventional liquid chemical booster stage for a vertically launched space vehicle. Geometric properties of all significant components were derived in parametric form. Results were summarized in schematic dimensional diagrams for two arrangements of tanked bipropellant fluids. These results will serve as a basis for formulating mass parametric equations as required for performance and trajectory analysis. Author

N64-27246* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
POSSIBLE MATERIALS NEEDS FOR ENERGY ABSORPTION IN SPACE-VEHICLE LANDINGS
Robert W. Warner and Donald R. Marble [1964] 40 p refs Presented at the Joint ASTM-ASME Symp. on Newer Structural Mater. for Aerospace Appl., Chicago, 21 Jun. 1964
(NASA-TM-X-54070) OTS: $3.60 ph

In the design of systems to absorb the landing impact energy of space vehicles, such as the system which will be used to protect the Lunar Excursion Module of the Apollo spacecraft in touching down on the moon, the specific energy absorption (energy absorbed divided by the weight of the material deformed) is not necessarily the primary factor. Other factors that must be considered include the compatibility of the deforming structure with its support, the packaging

volume of the system, the control of penetration into the landing surface, and the desirability of the system with respect to tipover stability and maximum permissible acceleration. These factors can lead to consideration of systems that do not employ energy absorbers of maximum efficiency. Materials improvements leading to better energy absorption in these systems could result in significant gains, particularly for the systems having relatively inefficient absorbers. Author

N64-27331 Atomics International, Canoga Park, Calif.
SIMPLIFIED FORMULAS AND CURVES FOR BELLOWS ANALYSIS
R. A. Winborne 1 Aug. 1964 40 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9848) OTS: $1.00

Development is presented of (1) a digital computer program (based on an asymptotic solution of equations from small deflection theory of shells) for solution of problems relating to shallow shell-shaped welded bellows, and (2) associated curvature correction charts with four parameters on one sheet of regular coordinate graph paper. A design section, in simplified form, is included for solution of problems encountered in shell-, convolute-, and toroid-shaped bellows. Author

N64-27446 Air Force Systems Command, Wright-Patterson AFB, Ohio Systems Engineering Group
STRESS ANALYSIS OF THE EXTERNAL FRONT WINDOW OF THE X-20A (DYNA-SOAR)
Verner J. Johnson Jun. 1964 37 p refs
(SEG-TDR-64-16; AD-603356)

The structure of the external front window of the X-20A is analyzed. A sophisticated matrix method of analysis, rather than a classical analytic method, was used to determine the behavior of a window of the X-20A reentry vehicle under loads and temperatures. A computer solution provides results that can be used for future developments of reentry vehicles and reveals areas that should be given further study. Author

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